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Ethnomathematics in Aceh Coastal Children's Football Game

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ABSTRAK

Setiap budaya memiliki matematika sendiri, dan matematika lahir dari budaya. Dan etnomatematika ada sebagai penghubung antara matematika dan budaya. Penelitian ini bertujuan untuk menganalisis etnomatematika yang terdapat dalam permainan sepak bola anak pesisir Aceh. Jenis penelitian eksplorasi ini menggunakan pendekatan etnografi. Subyek dalam penelitian ini adalah anak-anak pesisir Aceh yang berusia lima sampai dua belas tahun yang sedang bermain bola pada sore hari yang berjumlah 18 orang. Pemilihan subjek penelitian dilakukan dengan menggunakan teknik incidental sampling. Pengumpulan data dilakukan melalui observasi, wawancara, dan dokumentasi. Ada empat bentuk analisis data dalam penelitian ini seperti tema domain, taksonomi, komponen, dan budaya. Hasil penelitian ini menunjukkan bahwa anak-anak saat bermain telah menggunakan pengetahuan matematika seperti konsep garis lurus, penjumlahan dan perbedaan, perbandingan, teori peluang, bilangan dan pembulatan, dan pengukuran, tanpa disadari. Selain itu, konsep matematis yang digunakan dalam permainan sepak bola menunjukkan bahwa anak-anak pesisir Aceh memiliki etnomatematika sendiri, terbukti dengan mampu melakukan pemodelan matematis, memahami konsep rukun, dan berargumentasi. Sehingga etnomatematika dalam permainan sepak bola anak pesisir Aceh ditunjukkan dalam bentuk perilaku matematis yang mencerminkan pemahaman anak terhadap masalah dan cara penyelesaiannya menggunakan matematika.

ABSTRACT

Each culture has its own mathematics, and mathematics is born of culture. And ethnomathematics exists as a link between mathematics and culture. This study aims to analyze the ethnomathematics contained in the soccer game of Aceh's coastal children. This type of exploratory research uses an ethnographic approach. The subjects in this study were Acehnese coastal children aged five to twelve years who were playing ball in the afternoon, totaling 18 people. The selection of the subject of the study was carried out using the incidental sampling technique. Data collection is carried out through observation, interviews, and documentation. There are four forms of data analysis in this study such as domain, taxonomic, component, and cultural themes. The results of this study show that children, while playing, have used knowledge in mathematics, such as the concepts of line alignment, addition and difference, comparison, the theory of opportunity, numbers and rounding, and measurement, without realizing it. In addition, the mathematical concepts used in football games show that Acehnese coastal children have their own ethnomathematics, as evidenced by their being able to do mathematical modeling, understand the concept of harmony, and argue. So that ethnomathematics in the soccer game of Aceh coastal children is shown in the form of mathematical behavior that reflects children's understanding of problems and how to solve them using mathematics.

1. INTRODUCTION

The challenge for 21st-century educational systems is to understand how social and communication contexts influence students' perceptions and prior knowledge. One of the quandaries is that people's places, habits, traditions, and knowledge differ, so their understanding of the problem's context differs (Abtahi, 2022; Tait-McCutcheon & Loveridge, 2016). But nowadays, mathematics is taught in schools, and it's as if the spirit has died. Mathematics that has been "educated" is simply omitted. Spontaneous mathematics is a natural ability that was inherited but suppressed. Then this ability began to

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fade and was not integrated with the mathematical abilities learned in school (Rosa & Gavarrete, 2017; Widada et al., 2019). Mathematics should be viewed as an action, a human activity, and a process of developing a consistent logical framework from the past to the present through various cultures that can be used as a lever in overcoming word problems, particularly authentic ones that are significant. It's just that in mathematics classes, learning is often limited to mathematical techniques, rules, theorems, and mathematical training, as well as stimulus to solve problems that aren't related to the real world and the stimulus isn't always in accordance with the child's perspective on (Huf & Kluge, 2021; Malalina et al., 2020; Prahmana & D'Ambrosio, 2020).

When students can understand problem text information, translate it into mathematical form, and then take action to overcome or solve problems, the learning process is considered prominent. In fact, there are numerous methods for learning mathematics in real life, which eventually lead to new discoveries in the field of mathematics. Mathematical learning should be tailored to real-life and sociocultural contexts. So that there is no conflict where there is a disparity between the cultural traditions shared by the child outside of school and what they find in school, so that children claim that mathematics is not a part of their lives and is not important to learn (Bayeck, 2018; Brousseau & Warfield, 2014; Katsap et al., 2016).

As a result, a science that can connect mathematics and culture is required. The connection is ethnomathematics. Researchers in ethnomathematics investigate how different cultural groups understand, articulate, and apply ideas, procedures, and techniques identified as mathematical practice (D'Ambrosio, 2018; Nur et al., 2020). Ethnomatanatics as a much broader research paradigm than the traditional concepts of mathematics, ethnology, and multiculturalism in other writings. Etno refers to various groups distinguished by cultural traditions, codes, symbols, myths, and distinct ways of reasoning and inferring (Prahmana et al., 2021; Wahyuni, 2018). Ethnomathematics is defined as the study of various ways of knowing and the promotion of epistemological reflection on the nature of mathematical knowledge: the mathematical concepts introduced by ethnomathematics are centered on the idea of mathematics as a tool for understanding and controlling reality (practical dimension), as a system of rules and symbols shared in a community to communicate (social dimension), and finally as part of cultural heritage (cultural dimension) (Albanese et al., 2017; D'Ambrosio, 2018).

The study of ethnomathematics in its practice requires researchers to dialogue with cultural ethnic groups, with intellectuals, craftsmen, professionals, and members of invisible societies. Ethnomathematics can be used as a program that is relevant to the curriculum so that it can build knowledge according to the needs and culture of students in its environment (Rosa & Orey, 2011; Wahyuni et al., 2021). Thus, ethnomathematics can be defined as the incorporation of various cultures in society into mathematics as a whole. The study of ethnomathematics not only reveals the snobbery of mathematics but also emphasizes the complexity of each system, with a variety of practices emerging and used in specific socio-cultural and historical contexts (Choeriyah et al., 2020; Friend, 2014; Verner et al., 2013). Mathematics cannot stand alone because mathematics is an activity of a person or group. Every mathematical activity involves humans either directly or indirectly (Rosa & Orey, 2015; Wiryanto, 2020).

Ethnomatematics studies can provide us with an understanding of how mathematical ideas are generated and how these ideas have evolved through human history. So that ethno-mathematics can be used as an option in banning mathematics (Fouze & Amit, 2018; Supriadi & Arisetyawan, 2020), especially those related to games. It is believed that learning mathematics associated with games can improve students' understanding abilities (Dele-Ajayi et al., 2016; Luo et al., 2021). However, cost constraints are the main obstacle, so games based on local culture can be a solution to learning mathematics (Bayeck, 2018; Owusu-Mensah & Baffour, 2015). For this reason, a special study is needed that analyzes ethnomathematics in children's games.

Such as the research conducted by previous study which described several traditional games such as ta'ab, folklore, and mozkad that are similar to the seribal stone game in Indonesia (Fouze & Amit, 2018). They describe the process of playing the game and the math skills that can be improved in the game, but do not describe how the game builds children's math skills. It is different from Maryati and Rully's writing in their discussion of the application of the Pythagorean formula to making stilts (Maryati & Prahmana, 2019). Other study also found connection between the ethnomathematical values of treasure seekers in the Musi River and school mathematics (Malalina et al., 2020). If we think deeper, not all artisans or people have the knowledge of mathematics that is produced by mathematics schools. One can understand that the various mathematics present in the everyday lives of different subjects belonging to the same form of life have their own rules of usage and that they appear alongside each other, rather than as impositions associated with school mathematics (Hidayat et al., 2018; Osterberg & De Lara, 2019). So this study aims to analyze the ethnomathematics in the football game of Acehnese coastal children, and the focus of this research is not on the mathematical knowledge possessed by an individual but on the

mathematics present in the individual's behavior. For example, as a child's mathematical behavior, making goals, shooting high at goalposts, and the systematics of the game will provide a new color in understanding mathematics and reveal that children have a basic ability in solving more complex mathematical problems later.

2. METHOD

The type of research used is explorative, using an ethnographic approach. This approach was chosen to obtain an in-depth description and analysis of culture based on the physical settings, actions, activities, interactions, patterns, meanings, beliefs, emotions, and objects to be studied (LeCompte & Schensul, 2010). The subjects in this study were 18 Acehnese coastal children, ages five to twelve, who were playing football in the afternoon. The selection of research subjects was carried out using the incidental sampling technique. The selection of this subject was based on consideration of the suitability of the sample as a data source, with the main criterion being that the actions taken had ethnomathematic elements so that the sample could not be determined with certainty at the start of the study. Data collection methods are interviews, observation, and documentation. Interviews were conducted with coastal children who play soccer with the instrument grids as show in Table 1.

Tabel 1. Interview Instrument Grids

No	Indicators	Description
1	Agreement in Request	1. Team division process
		2. The process of making a game device (wicket)
		3. How todetermine the order of the team that plays first
2	Play process	1. What to do in the game
		2. The process of getting values / points
		3. How to record the values collected by the group
3	Determining the Winner	1. The process of calculating the value / point obtained
		2. How to determine the winner
		3. Decision making in determining rewards / punishments

The interview instrument has been validated by three validators who are competent in their fields. Instrument validation assessment uses the Content Validity Index (CVI) assessment sheet, which consists of 2 categories: valid (1) and invalid (0) (Almanasreh et al., 2019). There are four forms of data analysis in this study: (1) domain analysis to obtain a general and comprehensive description of the Acehnese coastal children's football game; (2) taxonomic analysis to describe the selected domain in more detail and find out the internal structure through in-depth observation of each game structure; (3) component analysis to look for specific characteristics and to contrast each element through triangulation analysis of selected observational data, interviews, and documentation; and (4) analysis of cultural themes to look for relationships between domains and how relationships with the whole are then narrated in text form (Garrido, 2017).

3. RESULT AND DISCUSSION

Result

Football is a sport that uses a ball made of leather and is played by two teams. Each team consists of eleven core players and several reserve players. Football aims to score as many goals as possible by using the ball against the opponent. Football is played on an open, rectangular field, on grass or artificial turf. These are the general rules of the game of football that almost everyone knows. However, limited space and facilities make children on the coast of Aceh play football in empty fields without grass. The game starts with a team. The number of team members does not have to be eleven core team members and no substitutes. They just played according to the mutual agreement they made. Based on the agreement, each team found seven players. The other four children were onlookers. Then the total number of children is 18. At the beginning of the game they made a goal, with the width of the goal 2 meters and the height of the goal being determined by the length of the goal post they made. When one of the children was asked about this difference, the child answered the important thing is to agree, no more fighting. Both goals must have the same goal width, if they are different, the bigger one will benefit the opposing team. The child determines the width of the goal is show in Figure 1.

Figure. 1. The Child Determines the Width Of The Goal With the Sole of the Foot

The goal creation continues as seen from Figure 1. A child measures the goal using the sole of his foot. The starting point of the measurement distance starts from the initial stake that has been made to the end point, which is 18 feet. They assume that 18 feet equals 2 m. Children measuring the length of the goal is show in Figure 2.

Figure. 2. Children Measuring the Length of the Goal Using Wood

The researcher asked the question "can it really be considered the same as 18 feet with 2 m? A child in a high tone answered "*hai ibu, panyang badan ke 120 cm, baroe diukoe le ibu perawat yang jak u sikula. Menyoe panyang ke 120, kaye nyoe panyang jih 60 cm*. (Hi mam, my height is 120 cm, yesterday was measured by a nurse who went to school. If my body is 120 it means this wood is 60 cm tall). The child compares his height with the wood he is holding. "Why can it be 60 cm? How did you know that?" Researchers keep asking questions, they smoothly answer. "*ta bagi dua manteng, kaye nyoe sikhan dari badan long*?" (We compare, then this wood is half of my body) now we measure the goal that has been made! They began to calculate the width of the goal using wood as shown in Figure 2. They add 60 + 60 + 60 + 20 so the total is 2 m. When asked "Where does 20 come from?" the measuring child said "*kan sepertiga dari kanye nyoe ibu? Ta bagi lajue enam ploeh ngoe lhee! Hasil jih, dua ploeh*." (Isn't it a third of the wood, isn't it? Sixty divided by three! That's twenty).

After the goal is made, they start the game. The team that kicks the ball first is determined by using a coin. This soccer game is 45 minutes long. After the game is over, and they rest. Interview continued. The question begins with "how to determine, which team kicks the ball first?" one of them answered "*ngon peng logam, ta undi*!" (with coins, we draw). *Menyoe reut, gamba cicem tim long yang me'en fhon, menyoe angka tim jieh yang me'en*. (If a picture appears, my team will play first, if it is a number, then his team will play). If it is toss, do you know that your team will kick the ball first? They answered "*Hai ibu metuah, pane na long teu pue. Yaeng pahsti, menyoe kon tim long yang fhon, tim jim lah*." (how could I know that, Mam? For sure, if not my first team, it must be his team). Researchers keep asking How do you know who won? no one records the goals or counts them. They answer: The winner, it must be the one *jai peu tamong bola. Keupue tatuleh? Ta surak manteng. Maseng-maseng kon, kah teu peu padum bola jih tameng.* (The winner is the one who puts in the most balls. What is it written for? Let's just scream. Everyone who plays knows how many balls he has put in). What if there is a dispute or a fight because the calculation results are not the same? *Hana dawa buk. Kan hasil lawan ngon tanyoe ta pegah chit, lage*

bunoe pheut – lee. Pheut tim kamoe, lee tim awak nyan. (no ma'am, no fighting. We also mention the results of the opposing team, like earlier 4 – 3. 4 for my team 4 and the opposing team 3).

Discussion

Ethnomathematics uses broad mathematical conceptions, particularly the activities of counting, discovering, measuring, designing, playing, and explaining (Cimen, 2014; Izmirli, 2011; Nur et al., 2020). Every culture, both western and eastern, has a relationship with mathematics. like the various number symbols in the world. This shows that each culture has its own mathematics, and mathematics is born from that culture (Bender & Beller, 2018; Kolar & Hodnik, 2021). This research wants to highlight the rules of using mathematical knowledge in football games because the focus of this study is to analyze the mathematical knowledge of Acehnese coastal children from an ethnomathematical perspective. Acehnese coastal children play football according to the mutual agreement they made. Based on the agreement, each team found seven players. The other four children were onlookers. In the process of making wickets, the wide and target heights should be 2.44 m and 7.32 m, respectively. The agreement they set and the actual rules for determining the size of the target are different, namely 2 m and 2.44 m, with a difference of 0.44 m or 44 cm. They were unaware that the wickets they made differed in thickness, but because the two wickets were identical, they agreed with the measurements. This shows that they understand the concepts of measurement and difference. They also have knowledge of the width of the goal and the difference between the actual rules and the ones they make. They also know that the two goals must be the same width in order for the principle of justice to remain, so as not to harm or benefit the opposing team. In school mathematics, two geometric lines are said to be parallel if they lie on a plane that will not intersect even if infinitely extended. so that the goals they have set can be said to be parallel.

The geometric concepts they use and understand are very different from school geometry. They do not form a line, assuming that the two lines marking the destination are parallel. But they consider the two lines to be the same length, or the language they use is the same, using the same measuring instruments. Although the distance between the two starting points of measurement is not the same, This shows that the knowledge, analysis, and problem-solving skills they have surpass the knowledge of mathematics taught in schools. Some ethnomathematics research shows that societies with their culture have extraordinary mathematics, which they do not learn in school and even surpass mathematics in schools (Hardiarti, 2017; Lubis et al., 2018; Prabawati, 2016; Prahmana & D'Ambrosio, 2020; Sroyer et al., 2018). Likewise, with this coastal child of Aceh, I only use eye vision measurements to determine the starting point of measurement. Indeed, this is not the standard starting point as described in schools. School mathematics has precise and indisputable rules that must be known in order to be used in the form of life prescribed by the school (Osterberg & De Lara, 2019; Soucy McCrone, 2005). Whereas in their games, rules exist as instruments of the game itself and are capable of making decisions.

When coastal children measure the lengfisherman practiceth of the icket by theirng the soles of the feet, it can be assumed that they can use unusual units. Automatically, measuring the length of an object using the soles of the feet causes the validity value of the measurement to decrease, considering that each child has a diffe nt eg length. But the coastalmakeld, able to give the assumption that the measurements taken were correct because of the habits they always used, thus giving confidence in their accuraabout. This assumption of coastal chi ren is the same as previous research related to a fisherman in making nets using a wide finger size (Saldanha, 2015). In his study the fishermen assume that, assuming the difference in the size of each individual's fingers, they can show confidence in the validity of the measure. After all, fishermen use it. Although the measuring instruments they use are invalid, confidence in the measurement process they carry out has a more pronounced effect. In real life, forms, sizes, and measuring instruments are not all the same.

Our logic of thinking becomes intrigued when we realize that these coastal children have confidence in the measuring instruments and ways of measuring that they use. While in school, many teachers and researchers struggle to increase the confidence of their students in solving math problems (Ackerman & Thompson, 2017; Novak & Tassell, 2017; Surya et al., 2017). Could it be that their confidence when dealing with mathematics in school has died? Because this study did not examine the comparison of confidence in depth, it requires additional research for future studies. The discussion continued on the assumption that Aceh's coastal children understood the basic idea of measurement based on their beliefs about the validity of the actions taken with the soles of their feet. They understand that every measurement must start from the starting point or origin of the measurement. They also understand units and are able to make abstractions. If the child stops thinking and is used to reasoning as taught in school, they will definitely use measuring instruments (for example, rulers) to create goal segments, which becomes a troublesome thing due to limitations and environmental conditions just because of their needs to play. This condition proves how the emic perspective allows children or us to discover new

conceptualizations of mathematical ideas (numbers and geometrics) (Khasanah et al., 2021; Kolar & Hodnik, 2021; Sumirattana et al., 2017). In this regard, they have understood the concept of measuring length intuitively, both numerically and geometrically.

Children's analytical and creative abilities are also high. The child's ability to communicate the idea of the problem can be seen when he proves that 2 meters is equal to 18 feet using a piece of wood. This shows that the child has been able to become a model. Modeling, which is a different style of abstract thinking in the world, can be studied with ethnomathematics (Abdullah, 2017; Rosa & Gavarrete, 2017). However, the concepts applied in the modeling process carried out by children using units of foot or wood are the rules that they make according to their needs. These rules, therefore, do not give them proper restrictions, in contrast to school mathematics, which imposes precise restrictions on the use of rules (Osterberg & De Lara, 2019; Sumarsih et al., 2018). Through games, children's incredible capacity for modeling or symbolization gives them a powerful tool to understand their environment and create and organize environmental events that touch almost every aspect of their lives later in life. By symbolizing the meaning of the child and performing abstractions, the child subsequently transforms temporary experiences into cognitive models that serve as a guide for judgment and action (Adamura & Susanti, 2018; Auliya, 2019; Chong et al., 2019).

In addition to communication skills, the ability to understand the concept of division has been mastered correctly, where they divide 120 cm by two to get 60 cm and divide 60 by 3 or 60 by 1/3, which results in 20. Comprehension is the ability to explain a situation or action. In addition, the explanation is accompanied by evidence in different ways (Tanujaya et al., 2017; Thuneberg et al., 2018). One of the characteristics that a person can use good mathematical knowledge for is the readiness to connect two or more basic procedures for building solutions to solve problems in different ways (Senk & Thompson, 2020; Suryani et al., 2020). In determining which team kicks the ball first, they use a lottery in the form of coins. This suggests that coastal children understand the material of opportunity. As can be seen from the results of the researcher's interview, in which one of the children stated, "For sure, if it wasn't my first team, it would be his." From the phrase, we can conclude that the child knows the odds of his team coming out as the winner: 1: 2 or 50%. Football games teach children the concept of numbering on number material in addition to opportunity material. For example, when a child counts the number of goals he scores, Children will count and add up starting from one blank, two ones, and so on. It is a process carried out to construct the ideas they have compiled so that they become concepts acceptable to others (Albanese et al., 2017; Huf & Kluge, 2021).

It is in line with previous study awhich discusses the game Gelengku Teu Peu Poe, or in Javanese society, the catfish peg game (Wahyuni et al., 2021). This study reveal that children are teachers themselves; they find their own mathematics and solve problems in their own way. This game teaches the basic concepts of geometry. Similarly, with other research that discusses the relationship between mathematics and community culture (Hasanuddin, 2017). Because ethnomathematics appears not only in football games but also in practical and abstract manifestations of the human species (Rosa, 2018; Vasquez, 2017).

The imolication of this study providing lot of ethnomathematics that exists in the Aceh coastal children's football game, such as the concepts of line alignment, addition and difference, comparison, chance theory, numbers, and rounding. Children have the ability to express themselves freely, allowing them to maintain their arguments and confidence in the measuring instruments and problem-solving process. But this research is limited to analyzing the ethnomathematics that exist in the game of football. Some studies still need to be carried out in depth, such as comparing children's self-confidence when solving problems in everyday life with existing mathematical problems at school. Then, the description of this study does not eliminate the Acehnese regional language used by coastal children because language has its own meaning and uniqueness. It is important to note that the use of language has rules that we call grammar; this frequently clashes with school mathematical modeling. This study has not looked at the languages used by Aceh's coastal children. Due to the existence of a universal language, it is hoped that subsequent researchers can look at ethnomathematics from the perspective of a new dimension. So that future research can dig deeper into the findings.

4. CONCLUSION

The mathematical concepts used in soccer games show that Acehnese coastal children have their ethnomathematics, which is demonstrated by their ability to do mathematical modelling, understand the concept of pillars, and be able to argue. The extraordinary ability of young people to symbolize Every measurement must start from a starting point or origin of measurement, just as a young child learns the basics of measurement. They can also understand the concepts of numbers, division, and probability

theory. It shows how environment and culture significantly impact children's cognitive, emotional and motivational development. Children will become stronger when they learn from nature. As a result, ethnomathematics in football games for Acehnese coastal children is manifested as mathematical behaviour that reflects children's understanding of problems and how to solve them using mathematics. Ethnomathematics can help develop a more global perspective on school mathematics.

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