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EXPLORATION OF MATHEMATICAL OBJECTS IN THE *BALALE'* TRADITION AS AN EFFORT FOR MODULING IN THE DAYAK SALAKO CULTURE AT *NYARUMKOP*

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ABSTRACT

This study aims to explore mathematical objects in the *Balale'* tradition of the Dayak Salako tribe in *Nyarumkop* Village and then integrate them into the Creation of Culture-Based Modules. The research method used is the ethnographic method, and the type of research used is qualitative. The *Balale'* tradition is one of the habits of the *Nyarumkop* farmers when working the rice fields collectively and in rotation. The *Balale'* tradition aims to strengthen relations between communities, because the community works together in the fields to complete tasks such as clearing land, planting rice, clearing grass, and harvesting rice. The results of the study show that the *Balale'* tradition has a direct mathematical object in the form of facts that lie in the people who join the *lale'an* members, the concept lies in the process of working the rice fields which are carried out in turns, the principle lies in the mindset of the community in carrying it out and the skills lies in the work technique of each member of *Lale'an*. This research also contains indirect mathematical objects in the form of discipline shown by *Lale'an* members in carrying out this tradition. Then it is mathematically integrated into the creation of a culture-based SPLDV Module using mathematical concepts.

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1. INTRODUCTION

Education is a means that must be obtained by every human being. Education always keeps up with the times and continues to be embedded in every human life. One of the factors that make education must continue to develop is culture. Culture and education have a relationship with each other. In line with this, Normina (2017) states that through education, cultured humans can be developed, and culture can also direct individuals to always adhere to norms or laws that have been made as a standard of living. The same thing was conveyed by Rahtowo & Budiyono who stated that education and culture can produce virtuous people by preserving norms or laws that have become a way of life (Rahtwo & Budiyono, 2022).

One of the sciences attached to education and culture is mathematics. Mathematics is a comprehensive science that exists in every aspect of human life. Mathematics is part of human daily life. Therefore every activity made by each individual is inseparable from mathematics. Mathematics has an important role in solving every problem that exists in human life (Dosinaeng et al., 2020). The development of mathematics is inseparable from the culture possessed by humans.

Mathematics develops as a result of life challenges faced by humans in various regions and cultures (Rachmawati, 2012). Thus, it can be stated that mathematics is a cultural product resulting from the abstraction of human reason as a problem-solving instrument and has a close relationship with the development of local culture. Using mathematical concepts and theories, mathematics is usually applied in everyday life to calculate, reason, or solve various problems. According to Bell (Minarni et al., 2021) Mathematics has direct objects such as facts, ideas, principles, and skills, and indirect objects such as the ability to think logically, solve problems, think analytically, have a good attitude towards mathematics, be thorough, work hard , and discipline.

Culture is an aspect of everyday life that cannot be avoided because it is an integral and inseparable part of a society or group (Putri, 2017). Where, culture is a legacy of behavior which includes knowledge, beliefs, morals, laws, arts, customs, and norms. Mathematics and culture are things that cannot be avoided in everyday life.

According to E.B. Tylor, culture is the unity of human activity which includes knowledge, belief, art, morals, laws, customs, and other behaviors. However, in anthropology, culture is a unified system of actions, ideas, and human creations within the framework of the existence of a society related to humans through learning. This explains why almost all human activities are cultural because very few human actions in the context of societal life do not require acculturation. In contrast, cultural historians define culture as the heritage or traditions of a society (Rahmawati Z & Muchlian, 2019).

Each region or tribe, including the Salako Dayak, must have a unique cultural tradition. The *Balale''* tradition is one of the cultures owned by Dayak Salako which contains mathematical objects. Residents of *Nyarumkop* Village, East Singkawang District, West Kalimantan continue to carry out this tradition. Most of the Dayak people in *Nyarumkop* Village have a livelihood as rice farmers. The subsistence system is a system used by humans to fulfill their basic needs, especially for subsistence through animal husbandry and farming (Pertiwi & Budiarto, 2020). The *Balale''* tradition is one of the cultures passed down from generation to generation, and the people in *Nyarumkop* continue to practice this tradition from their ancestors in farming. Farming activities carried out by the community are rice fields.

In the *Balale''* Tradition, teaching and learning processes and strategies with values are anticipated to help students instill good attitudes and understand the mathematical objects contained therein. Students will recognize the relationship between culture and mathematics if they study mathematics that incorporates cultural elements (Dosinaeng et al., 2020).

Introducing local culture and customs that are still enforced by some groups of people will make learning more memorable. This is achieved by taking into account the mathematical skills developed by different subgroups of people and by taking into account the different approaches adopted by each culture (Prahmana & D'Ambrosio, 2020).

Ethnomatematics is the process of incorporating local culture containing mathematical objects into formal mathematics education. It is the same as opinion Shirley (Marsigit et al., 2016), that currently the ethnomathematics disciplines that emerge and develop according to local culture are at the center of the learning process and learning methodology. Educators can introduce mathematical objects to students in various ways, including by utilizing modules. The *Balale'* Tradition will be included in the SPLDV-based Module. This module is designed to make it as simple as possible for local students to understand mathematical objects. Students will find it easier to understand abstract SPLDV material if they use examples from everyday life.

TIMSS and PISA study results place Indonesia in a low ranking (below average). This is due to the lack of students' mathematical abilities in solving reasoning questions & problem solving due to the lack of giving portions of reasoning and solving problems in teaching materials and practice questions to students. In addition, the facts in society show that many students fail to get actual math scores, because they are only motivated to meet the target test scores. This results in concerns about students' inability to apply mathematics to solve problems in everyday life.

The existence of these problems provides a common thread that we should seek various alternatives and innovations in order to improve our students' mathematical abilities. One of the keys is improving the learning process in schools, especially by increasing the portion of reasoning, solving problems, arguing and communicating through teaching materials that are more contextual. Because the researcher deems it necessary to write about "Exploration of Mathematical Objects in the *Balale'* Tradition' as an Effort to Make a Module on the Culture of the Dayak Salako Tribe in *Nyarumkop*" as a special study on mathematics which is owned and practiced by the community for generations, which is expected to be a reference material contextual mathematics learning.

In order to help students do their school work, it is necessary to investigate the mathematical objects that exist in contemporary culture. Therefore, students' understanding of mathematics must be based on their daily experiences. The exploration of the *Balale'* Tradition which contains mathematical concepts is the first step and the main focus of this investigation.

Ethnomatematics in learning can help students to better understand learning mathematics and respect culture. Students will realize that mathematics is not only exact learning that only exists in schools. But learning that can be applied and utilized in everyday life even in culture.

Integrating local culture that contains mathematical objects into formal mathematics learning is by ethno-mathematics. The field of ethnomathematics that arises and develops in society according to local culture is the center of the learning process and teaching methods. There are various ways that educators can do to introduce mathematical objects to students, one of which is by using a module. Modules that will be integrated into the *Balale''* tradition are modules on SPLDV material. The module is made as well as possible to make it easier for students to understand mathematical objects in the local culture. Students will find it easier to understand abstract SPLDV material by using things that happen in everyday life. Ethnomatematics will make learning mathematics closer to everyday life because it connects mathematics with cultural elements where students grow and develop.

The purpose of this study was to find out the mathematical objects contained in the *Balale'* Tradition of the Dayak *Nyarumkop* tribe in Singkawang Timur District and to find

out the making of modules in class VIII on the material System of Two Variable Linear Equations (SPLDV) containing the mathematical objects of the *Balale'* Tradition. The research conducted is the first step in conducting development research. So that this research will be used as material for analysis and literature review to conduct further research.

This research will explore mathematical objects in the *Balale''* tradition of the Dayak Salako tribe in *Nyarumkop* Village and then integrate them into the Culture-Based Module Creations. The findings from studying the elements of the *Balale'* Tradition will be used to develop a Mathematics Module on SPLDV material that respects the socio-cultural environment and local wisdom of the community in future research.

2. METHOD

The methodology used in this research is ethnography. Creswell (Wijaya, 2015) suggests that, ethnography is a qualitative research method for characterizing and analyzing various cultural groups that interpret patterns of behavior, beliefs, and language that develop and are used from time to time by a group of people.

Arikunto (2016) states that the research subject is the subject intended to be investigated by the researcher. The subjects in the research conducted were members of the Salako Dayak tribe who still carry out the *Balale'* tradition in *Nyarumkop*, Singkawang Timur District, namely Mrs. Yussella (45 years) and one member of the custom community who understands the *Balale'* tradition, namely Mr. Hermanus (61 years).

According to Sugiyono (2017) The object of research is the attributes, characteristics, or values of a person, object, or activity that has been manipulated by researchers to study and draw conclusions. This research focuses on the *Balale'* Tradition which contains mathematical objects.

Nyarumkop Village, Singkawang City, is the location of this research. In this study the procedure was divided into three stages, namely the preparation stage, the implementation stage, and the conclusion stage. This study uses interviews, observation, and documentation to collect data. Data collection was carried out in several ways, namely observation, interviews, and documentation. The analysis carried out is to analyze the form of mathematics and classify it according to existing mathematical objects.

3. RESULTS AND DISCUSSION

Based on the data collected during the investigation in *Nyarumkop* Village, Singkawang City, information was obtained regarding the elements of the *Balale'* Adat. The interview which was conducted on March 19 2023 was used to collect data on 2 informants, namely one Indigenous member and one member of the community who carried out the *Balale'* Tradition. Observations began on Thursday 30 March 2023.

3.1. Results

The *Balale'* tradition was chosen because this culture is a culture that is carried out every year by the people in *Nyarumkop* Village, Singkawang City. This culture must be introduced early on to students. Mathematical objects such as direct mathematical objects consisting of facts, concepts, principles and skills as well as indirect mathematical objects consisting of analytical thinking abilities, thoroughness and diligence contained in this tradition need to be known by students. Integrating values in the *Balale'* Tradition in mathematics learning is expected to be able to help students instill character and understand the mathematical objects contained therein. When the values in the *Balale'* Tradition are

integrated into learning mathematics, students will better understand the meaning in learning mathematics, and can foster students' learning motivation in learning mathematics.

Before carrying out the *Balale'* Tradition, the *Balala*' traditional ritual is first carried out. This ritual is carried out with the intention of eliminating all negative influences from the agricultural process to the harvest period.

3.1.1. *Balala'* Traditional Rituals

The *Balala'* traditional ritual must be carried out before the *Balale'* tradition begins. This *Balala'* ritual is a ritual that is performed by abstinence. In the *Balale'* Tradition, the *Balala'* Ritual is believed to be able to ward off bad things that will happen which can cause the community to fail to harvest or produce less than optimal agriculture. This tradition is carried out by the Dayak Salako community, especially in *Nyarumkop* Village, to ask Jubata (God) for protection. The *Balala'* Traditional Ritual was carried out on March 31, 2023.

Prior to the implementation of *Balala'*, namely on March 30 2023 in the afternoon, a *Nyangahatn* will be held as part of the ritual with the aim of reading a prayer to Jubata (God) which will be performed by the traditional leader (*PeNyangahatn*). The local community, especially the men, will work together to prepare the materials to be used and clean the area around the place to be used in the *Nyangahatn* traditional ritual. The ingredients that must be prepared for this traditional ritual are 1 free-range chicken, tumpi (*cucur cake*), poe (glutinous rice), sunguh (plain rice), eggs, chicken blood, candles (companion offerings/other food offerings).

Figure 1. The process of preparing for the *Nyangahatn* Ritual

Nyangahantn will be held at a location determined by the traditional leader. After all the preparations are complete, the ritual will begin reading a prayer to Jubata (God).

Figure 2. The *Nyangahatn* Process

After the completion of the traditional *Nyangahatn* ritual, *Balala'* begins. This ritual is carried out for one day starting at 18.00 WIB and ending the next day at the same time. While *Balala'* is being carried out, people are prohibited from leaving their homes and are prohibited from receiving guests from outside until *Balala'* is finished. Every street and alley will be given a bar/sign that the *Balala'* Tradition is being carried

out and as a sign that it is forbidden to enter or leave the area. Communities who violate the rules in the *Balala'* Adat ritual will be subject to customary sanctions.

Figure 3. Signs/Signs of the Implementation of *Balale'*

3.1.2 Work System in the *Balale'* Tradition

In accordance with the *Balale''* Tradition, the rice fields are worked in turns. In the *Balale'* Tradition, group members consist of four to seven people, and whose turn is determined by whose land is available to work on and whose rice seeds can be planted. The daily work schedule in the *Balale'* Tradition starts at 06.00 and continues until 11.00, with a break from 13.00 to 17.00 WIB. For seven participants, the *Balale'* Tradition takes approximately nine hours. *Balale'* members who have received *Lale'an* are required to follow *Lale'an* in the fields of other *Balale''* members until all members have had their turn. If a member cannot attend the *Balale'* after receiving *lale'an* from another member, that member must send a replacement.

If during the implementation of the *Balale'* Tradition there are obstacles such as rain which makes it impossible to work in the fields, then the *Balale'* Tradition will be stopped and continued the next day at the same location. If the land worked on in this tradition is completed before the specified time, then the master of *lale'an* may invite other participants to return to their respective residences.

Figure 4. *Balale''* Tradition

3.2. Discussion

3.2.1 Mathematical Objects in *Balala'* Traditional Rituals

In the traditional *Balala'* ritual, it contains mathematical objects including direct and indirect objects. The direct mathematical objects contained in the *Balala'* customary ritual are facts, concepts, principles and skills. While the indirect object is the ability to think analytically, thoroughness and perseverance. Facts are agreements that are approved and implemented in doing something. In mathematics, facts are agreements approved by scientists, such as symbols, symbols, or rules. The concept is defined as an abstract idea that allows one to classify an object. Principle is a statement that contains the relationship between two concepts. While skill is a rule to obtain a result. For the indirect mathematical objects contained in the *Balala'* customary ritual

are the ability to think analytically, accuracy, and perseverance. In addition, the researcher also explained the steps for making culture-based Student Worksheets (LKPD) by utilizing one of the elements in the *Balale'* Tradition.

In the traditional *Balala*' ritual, the facts are found on the signs that are prohibited from entering the area that carries out *Balala'*. In practice, the sign is a symbol to the public not to leave or enter areas that have been marked or signposted. This implementation is included in the facts because the place or area to be given a sign is a joint agreement made by the local community. The concept lies in the offerings that will be used in the *Nyangahatn* process to prepare for *Balala*'. The preparation of offerings is called a concept because this process is a stage in *Balala*' that people already understand. The community already believes that the tradition being carried out will not take place legally without offerings before the ritual takes place. The principle in *Balala'* lies in the mindset of the people. Due to the provision that one cannot leave the house which is marked by a sign in front of the alley and the *Nyangahatn* process has been carried out with the offerings used, the community believes that this ritual can get rid of all bad things. This activity is called a principle because in the process of giving offerings, the process of giving signs, and the belief in getting rid of all bad things have a relationship with one another. Skills lie in the stages carried out when *Balala'* is carried out and when preparing the offerings. Because the offerings used in the *Nyangahatn* process have special rules that must be arranged to comply with the applicable provisions. This is called skill because in practice, the arrangement of offerings should not be haphazard or placed at random. The offerings must be specially prepared and require skill in preparing them so that the *Nyangahatn* process takes place perfectly.

The indirect mathematical object of the *Balala'* ritual is the ability to think analytically, to be thorough, and to be persistent. The ability to think analytically in the *Balala'* ritual can be seen from the beliefs held by the community where people believe that by doing this ritual, they will get an abundant harvest if they are able to think critically. In this case, the ability to think analytically lies in the mindset of the people towards the belief in an abundant harvest based on the efforts they make in carrying out all the traditional *Balala'* rituals. For accuracy in the *Balala'* tradition, it can be seen from when the community prepares offerings during the *Nyangahatn* process. When preparing offerings, it must be in accordance with the rules and requires accuracy. Accuracy is very important in the preparation of offerings because the offerings should not be arranged haphazardly. The rules for the preparation and ingredients included in the offerings have been determined by the customary leader. The community must follow these rules so that the ritual runs smoothly.

Table 1. Mathematical Objects in the *Balala*' Ritual

Activity	Math Objects	
	Direct Object	Indirect Object
Signs are not allowed to enter the village	Fact	Ability to think analytically, thoroughness, and perseverance
Stages in carrying out the ritual	Draft	
The mindset and belief in carrying out the ritual	Principle	
Preparation when Assembling offerings	Skills	

Meanwhile, perseverance can be seen from each individual who still adheres to and practices the *Balala*' tradition with a spirit of persistence and stops all activities outside the home while *Balala*' lasts. To clarify the distribution of mathematical objects contained in the *Balala*' ritual, they are classified in the table 1.

3.2.2 Mathematical Objects in the *Balale'* Tradition Work System

After carrying out the *Balala'* tradition, it is then continued with the *Balale'* tradition. The fact lies in the community joining the *Lale'an* members and working the rice fields in shifts, because the people who are members of *Lale'an* and work the rice fields in turns is a symbol that the *Balale'* tradition is being carried out. This symbol is an agreement that has been agreed upon by the community. The community agrees that everyone is obliged to work the fields of the *Lale'an* participants in rotation. This rule is used in the *Balale'* tradition. The concept is based on a rotational work system. Members whose land is willing to be worked on will be worked on their rice fields first, because cultivating the land in rotation is what distinguishes the *Balale'* Tradition's rice field work from other traditions. This concept has been ingrained in society since ancient times. In the *Balale'* Tradition, the principle lies in the mindset of the people. The community believes that if something is done collectively, it will feel lighter and it will be completed more quickly. People who practice the *Balale'* Tradition have skills because the people have mastered the techniques of the *Balale'* tradition which are carried out quickly and precisely.

The indirect objects of the *Balale'* Tradition include logical reasoning, problem solving, analytical thinking, positive attitude, rigor, persistence, and discipline. Have the ability to think logically because people believe that if done together, the work will be completed quickly. Have the ability to solve problems and the ability to think analytically because the community finds ways to work the land quickly by working on it together and can use tools that can help make work easier. It has a positive nature because it can strengthen relations between people. Have accuracy and diligence because in the process of community work must be in accordance with applicable regulations. Have discipline because in carrying out the *Balale'* Tradition, one must be disciplined within the mutually agreed upon time.

Table 2. Mathematical Objects in the *Balale'* Ritual

Activity	Math Objects	
	Direct Object	Indirect Object
Communities who join in *Balale'*	Fact	Ability to think logically, Ability to solve problems, and Ability to think analytically, thoroughness, and perseverance
The process of working the fields in turns	Draft	
Community Mindset	Principle	
Work technique of each member of the group	Skills	

The *Balale'* tradition also contains the mathematical concept of equations with the number of *Lalean*' members who can complete the work in one day. With 7 members, the *Balale'* tradition can be completed in one day or 9 hours. Of course, this can be compared with the number of members of 10 people, the *Balale'* tradition can be done more quickly. The equation can be made as follows:

7 members of *Lale'an* = 9 hours
10 members of *Lale'an* = ,,, hours
With this equation a formula can be made:

$7\ x\ 9 = 10\ x\ Y$
$63 = 10\ Y$
$Y = 6{,}3$

From this equation, if the members in the *Balale'* tradition are added to 10 members, the *Lale'an* work can be completed in 6.3 hours or 6 hours 18 minutes. This time is shorter compared to 7 members. This is what makes the more *Lale'an* members in the *Balale'* tradition, the faster the time needed. This element is used by the people of *Nyarumkop* Village in lightening their work.

Learning resources do not only come from textbooks, but can be supported from the environment and local culture which are more meaningful for students. In learning mathematics can be taught by using culture as a learning resource. Ethnomathematics as a bridge between education and culture is able to provide knowledge with added value to be understood because it is related to habits that are able to blend in with local traditions in learning mathematics. This is because ethnomathematics offers learning based on local culture so that students can recognize and explore the culture of their nation.

Exploring mathematical objects in the *Balale'* tradition is an effective method used so that students can understand mathematics learning and understand that mathematics exists in all aspects. More than that, culture-based mathematics learning can help students to get to know and love their own culture (Dosinaeng et al., 2020).

3.2.3 Preparation of Culture-Based Modules

The module designed in this study follows the characteristics required as a module according to Suastika & Wahyuningtyas (Suastika & Tri Wahyuningtyas, 2018), that is: *a) Self instructional, b) Self contained, c) Stand alone, d) Adaptif, and e) User friendly.*

a) *Self Intructional.* Modules can be used as independent teaching materials so that students can have the skills to explore information and develop it independently so they don't depend on the teacher. To fulfill the self-instructional character, the module must: (1) be prepared based on the independent teaching curriculum. This module will utilize Basic Competency A.33, namely solving mathematical models and contextual problems related to SPLDV, (2) Learning materials packaged with special activity modules must be loaded. The material contained in the module is SPLDV material related to the *Balale''* Tradition labor system, (3) There are illustrations and examples to support the clarity of presentation of learning material. (4) There are practice questions used to evaluate student work. The practical questions for this module relate to the workforce system in the *Balale'* Tradition, (5) Contextual, namely the material presented is relevant to the student's atmosphere, the context of the task or activity, and the environment. Modules are presented in accordance with the environment around students, especially the use of the *Balale'* Tradition system, (6) Use language that is straightforward and communicative, (7) There is a summary of educational content, (8) There is an evaluation tool. The evaluation instrument for this module uses the Benchmarking Research Approach (PAP), (9) Students receive feedback about their assessments, and (10) There is information about improving learning materials related to the *Balale'* Tradition.

b) *Self Contained.* The modules contain all the instructional content and are bundled as a single unit. This concept aims to provide opportunities for students to examine in depth SPLDV learning materials related to the *Balale'* Tradition.
c) *Stand Alone.* Modules that are independent or independent of teaching materials and other media. This concept is intended so that students do not need additional teaching materials in studying the module. If students still need other teaching materials in studying the material in the module, then it can be said that the module developed is not included as a stand-alone teaching material.
d) *Adaptif.* Module adaptation to scientific and technological advances is very important. This concept is intended to facilitate the adaptation of modules to advances in science and technology. Incorporating content that supports learning in modules such as audio, visual or audiovisual is an example of this adaptation.
e) *User Friendly.* Modules must comply with user-friendly or user-friendly guidelines. The goal of this concept is to make each module's instructions easy to use and useful.

4. CONCLUSION

There are direct and indirect mathematical objects in the *Balale'* tradition. The direct mathematical object is in the form of facts that lie in the individuals who take part in *Lale'an*, concepts that lie in the process of working the rice fields in turn, and principles that lie in the mindset of the people when carrying out *Balale'* Each member of *lale'an* incorporates tradition and expertise into work practice they. The *Balale'* tradition contains mathematical objects in the form of logical reasoning, problem solving, analytical thinking, positive attitude, thoroughness, perseverance, and discipline.

In the research conducted, the researcher provides several suggestions, including that it is necessary to hold a more in-depth exploration of mathematical objects regarding traditional rituals used in carrying out the *Balale'* Tradition and in designing modules it is expected to pay attention to the characteristics required by a module, namely: *a) Self instructional, b) Self contained, c) Stand alone, d) Adaptif, and e) User friendly.*

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