



Mathematical Representation in Reading *Cacaran* Script as a Pattern for Counting Operation of Whole Numbers

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Abstract. Motivated by the low motivation to learn mathematics which results in low achievement of basic competencies and the quality of student understanding in learning mathematics, so that learning innovations are needed according to student needs. The ethnomathematics approach was chosen to stimulate student's affectivity in learning mathematics, by involving culture as local wisdom raised to prove the correlation between mathematics and cultural life that students can find in the cultural wealth in the student's environment. The media used is the *cacaran* script to calculate pair matches that are still used as a local community belief. The results of the study concluded that (1) there are various cultural potentials as local wisdom owned by Cupunagara Village, one of which is the count *é*lmu palak regarding the calculation of pair compatibility using *cacaran* script, which has relevance to mathematics, especially in class VII number material; (2) students are able to represent mathematics in a cultural context through *cacaran* script on number material; (3) students are able to solve problems related to integer arithmetic operations; (4) learning mathematics using a local wisdom-based ethnomathematics approach is proven to affect student's motivation to learn mathematics for the better.

Keywords: mathematical representation, ethnomathematics, *cacaran* script

1 Introduction

Mathematics is one of the compulsory subjects at the formal education level, especially in Indonesia. According to [1] "mathematics is one of the subjects that is considered important in schools and society", this is related to Gauss' opinion [2] that "mathematics is the queen of sciences, and arithmetic is the queen of mathematics". Based on this opinion, it can be interpreted that mathematics is a broad science and is certainly useful in every line of human life.

But in reality, PISA (Program for International Student Assessment) data in 2018 shows that Indonesia ranks 73rd out of 79 countries in the math category. In addition, internationally according to TIMSS (Trends in International Mathematics and Science Study), Indonesian students are at the lowest stage [3], this can be seen in "TIMSS data in 2015, Indonesia ranked 44th out of 49 countries" [4]. [5] revealed that the problems

of the low quality of education in Indonesia include the low quality of physical facilities, the low quality of teachers, low student achievement, lack of equitable distribution of educational opportunities, and the low relevance of education to needs. In addition, the internal motivation of students is also one of the causes of the low quality of education. [6] revealed that internal factors are one of the factors causing student failure in mastering mathematics, among the internal factors that can affect students during the learning process are mental readiness, confidence, self-confidence, motivation and unyielding attitude.

In learning mathematics, in addition to student motivation that needs to be increased to support the learning process, it is also necessary to have an appropriate relevance between mathematics learning learned at school and mathematics that students can encounter in their environment. This is very necessary so that in the implementation of mathematics learning, student's questions that often arise regarding the relevance of mathematics material to life in their environment can be answered properly. Based on the results of interviews conducted with students in the low learning motivation category, including because so far students do not understand the purpose of learning mathematics for what, other than to do test questions and graduate from school. This is the trigger factor for researchers to explore the correlation between mathematics and the environment where students live by using a local culture approach to increase student learning motivation, as well as to show the closeness and connection between mathematics and real life in the environment where students live related to local traditions and culture.

Mathematics is considered abstract due to the views of students who do not understand the relevance between mathematics taught at school and things that students can read in the perspective of the real world, among the smallest scope that students can encounter is in the environment where students live, therefore, the cultural approach used by researchers to explore the relationship between local culture and traditions is read from a mathematical point of view. Student's inability to respond to this is also influenced by student's motivation in learning mathematics. At this research location, student motivation to learn is low, this is influenced by many factors, both internal and external. Even the pandemic effect is still a factor in low student motivation. This is supported by the results of the researcher's interview with one of the students who stated that because during the pandemic there was very little learning, so to start learning again it was still very difficult.

Based on the results of initial observations made by researchers with local customary leaders, there is a tradition that is still preserved from generation to generation including calculating good days using *cacarakan* script. This method of calculating good days can be used for various things, including good days to hold a marriage contract, celebration, starting work to build a house, traveling to find work, and many more. The *cacarakan* script used is represented in mathematical symbols related to arithmetic.

The variety of traditions and cultures that Indonesia has, ideally, can encourage teacher motivation in the delivery of local wisdom-based learning available in the region so that it can encourage student motivation in understanding mathematics learning. As Gauss's previous opinion that mathematics is a universal science and is able to collaborate with other sciences should be a great opportunity in mathematics learning

innovation so that mathematics can be presented well and can be well received by students, and can apply mathematics in the student's life environment. [7] revealed that local wisdom that can be used as a learning resource can be in the form of regional potential that becomes a local advantage, including (1) human potential, (2) natural potential, (3) artistic potential, cultural customs, and religion.

Cupunagara village, which can be called a remote village in the southern area of Subang Regency, has unique characteristics with culture, tradition and abundant natural resources. This can be used as material by researchers to find out the mathematical representation skills of students in seeing mathematics from a cultural point of view in Cupunagara Village to increase the motivation to learn mathematics of MTs Nurul Hikmah Cupunagara class VII students on number material.

2 Methods

This research uses ethnographic methods with a qualitative approach. "Ethnography is the work of describing a culture" [8], while the purpose of ethnography is to understand a way of life from the point of view of the natives. Qualitative research according to [9] is "methods for exploring and understanding the meaning ascribed to social or human problems". This study used a step-by-step forward research flow. Of the 12 main systematic steps according to Spadley's theory, the researcher only used 5 core stages based on the problem-solving process, including: (1) Determining informants, this was done by the researcher by means of observation to obtain information about the existence of cultural actors to determine the potential of culture and local wisdom owned by the research site. (2) Asking descriptive questions, at this stage the researcher asks questions related to the cultural potential and local wisdom of the research area. (3) Analyzing interviews, this stage is carried out by researchers to collect data obtained from descriptive interviews. (4) Determining cultural themes, this is done by the researcher to get the red thread and points that might be used as the potential of culture and local wisdom to be raised and its relationship with mathematics material that will be used as a theme in determining mathematics material in the school where the research is conducted. (5) Writing ethnography, this stage is done to make conclusions from the series of research and get the results of the research.

After carrying out these 5 stages, the researcher analyzes the material that can be used as material to be applied using the ethnomathematics approach. This is planned to increase motivation for students in learning mathematics. With the help of teaching materials that are made simply based on the design of the stages of the research flow according to Spradley.

The main subjects are 10 students of MTs Nurul Hikmah Cupunagara class VII in the 2021/2022 semester 1, consisting of 5 female students and 5 male students. The next subject in this study is referred to as key informants, the selection of key informants is taken purposively, the consideration in selecting key informants is aimed at cultural actors who can provide in-depth information about the potential of culture and local wisdom that is still maintained. Key informants are natives of Cupunagara Village who were born and grew up in the village environment.

Data collection techniques include using observation, questionnaires, interviews and documentation. The instruments used are observation sheets carried out to obtain key informants who are cultural actors as well as to find out the characteristics of students in representing mathematics learning, questionnaire sheets containing motivation instruments given to students to obtain information related to the level of student motivation in learning mathematics, interview guidelines used to find out information related to cultural potential and local wisdom to get cultural themes which are then selected to determine mathematics material for grade VII students, documentation is used as a source that provides data or factual information related to cultural elements expressed by key informants as well as valid evidence related to the research conducted.

Data analysis techniques are carried out by systematically compiling data obtained from observations, questionnaires, interviews and documentation. Data validity checking techniques are carried out using method triangulation techniques. Patton [10] suggests that there are two strategies for the purposes of checking the degree of data confidence using the method triangulation technique, namely checking the research findings of several data collection techniques, and checking using several data sources with the same method. In addition, data analysis is carried out according to Spradley's method, namely the results of cultural theme analysis.

3 Result and Discussion

Based on the results of research conducted for six weeks at MTs Nurul Hikmah Cupunagara, Cupunagara Village, Cislak Subang Regency, the results of questionnaires and interviews conducted with 10 seventh grade students, there are several students whose learning motivation is low and moderate. This is influenced by the low targets that students want to achieve after completing school, limited access to continuing education, also because students feel there is no connection between mathematics and their ideals, and it is difficult to understand the usefulness of learning mathematics to be applied in real life in the environment where students live if students do not continue to the next level. By examining the problems from the results of the analysis of student learning motivation questionnaire data, during previous mathematics learning activities, then through learning mathematics with a cultural approach to the local area, it is hoped that this can affect student's motivation to learn mathematics for the better.

Based on observations made in the research environment, it was found that to find out more about the culture and local wisdom of Cupunagara Village, researchers were directed to meet the LAD (*Lembaga Adat Desa*), one of which is an elder who is trusted by the community as one of the customary leaders in the village. The results of interviews obtained with elders who are key informants in this study state that one of the cultures that is still maintained, maintained, and preserved and is still believed by the community for generations, including calculating good days using cacarakan script. This can be used for various purposes and objectives, such as calculating good days for holding a marriage contract, celebration, trading, farming, building a house, traveling to find work, and many more. Even the count can also be used for small things such as determining the direction of the door of the house, determining the day and time when going on a long trip, naming a child, and so on. The calculation that is often referred to

as the *élmu palak* count is needed to determine the day, date, and even the hour of the event that has been described.

After analyzing the results of descriptive interviews with informants, based on Spradley's phased forward research flow, the researcher determined the cultural theme by raising the cultural potential of the *élmu palak* count as the local wisdom of Cupunagara Village. With the approval of the key informant, this sacred count was allowed to be published, so the researcher determined the mathematics material related to the local wisdom and culture of the region by applying learning in class VII, namely on number material.

At the time of this research, the number material had been taught at the beginning of the odd semester, and the motivation questionnaire given to students in the initial observation was the student's interpretation of learning the number material that had been taught previously. Nevertheless, this research still took place well as a flashback of the material and to increase students' motivation to learn mathematics before the PAS (*Penilaian Akhir Semester*).

At the beginning of the lesson, the researcher as the teacher delivered the learning objectives. The teacher started the learning by stimulating student's learning motivation by discussing the wealth of local culture owned by the area where students live. Then the teacher conducted a flashback about the number material that had previously been taught by conducting two-way communication. In this activity, the basic competencies in the learning objectives have not been achieved well, there are only 30% of the total 10 students who are able to remember and communicate the number material that has been taught.

Furthermore, the teacher again stimulates students with a discussion of the compatibility of couples who will marry as an initial concept of mathematics raised from local culture as a starting point for bringing cultural perspectives into the concept of mathematical abstraction, where the researcher aims to show that wedding days and compatibility of couples in accordance with the beliefs of students' parents and local communities can be calculated using mathematics. In this activity, the ethnomathematics approach continues to be carried out and is proven to increase students' curiosity to learn math number material.

Furthermore, the teacher conveyed the *cacarakan* script pattern or known as the *hanacaraka* script. According to [11] "cacarakan script is actually a script adopted by the Sundanese community from the Modern Javanese script commonly called *Carakan*". Meanwhile, according to Coolsma [11] "cacarakan script is called Sundanese-Javanese script". This is in accordance with the informant's statement in the interview, the informant mentioned that the *cacarakan* script was previously a Javanese script which was then modified to write Sundanese with the Priangan dialect. There are several differences between the Javanese version of the *cacarakan* script and the Sundanese version, including the Javanese version has 20 consonant letters while the Sundanese version has 18 letters only, because the Sundanese version does not have the letters *dha* and *tha*, in addition, the Sundanese version adds the vowels *é*, *e*, and *eu*. But now, the script recognized by the Sundanese tribe is the standard Sundanese script or *kaganga* script. Nevertheless, the *cacarakan* script is still used in the calculation of *élmu palak* in the Cupunagara Village community.

The following is the cacarakan script given by the informant and conveyed to students.

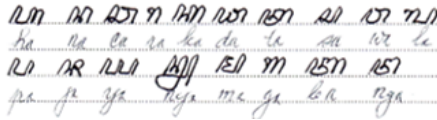


Fig. 1. Cacarakan Script

The cacarakan script introduced to students is the basis of the count of élmu palak to determine the count of various agendas, both big events such as determining the wedding day, naming children, and so on as described above. In the lessons delivered to students, researchers chose the cultural theme of determining the compatibility of the dominant partner favored by students.

Student’s interest in learning number material using the cacarakan script can be seen from the significant enthusiasm of students from the beginning of the teacher entering the room by conveying the purpose of reviewing the material at the beginning of semester one, compared to when the teacher provides a stimulus by using a cultural approach based on local wisdom by introducing the cacarakan script to determine a good day on the suitability of a couple who will carry out a wedding. In addition, another consideration is because to calculate the activity, it is analyzed to have greater usefulness for personal students to be used in their lives in the future. The determined cacarakan script times are presented as in the Table 1.

Based on the interview results, the informant mentioned that naktu is a number or value that has been determined to determine each letter. The origin of the naktu that was informed is based on the provisions that have been determined by the ancestors from generation to generation.

Therefore, the informant could not provide a detailed explanation as to why the sequence is like this. In addition, there is no specific book or book that provides an explanation of the naktu mentioned by the informant. All information provided by informants is purely given from generation to generation. In addition to the naktu aksara cacarakan on consonant letters, for vowel letters the value is 1 (one). The script that is given a value of 1 is usually used for names that use vowels at the beginning or in the middle of words or the end of which there are adjacent vowel letters. Vowel letters in Sundanese include a, i, u, é, e, eu, o. Another rule is that if the consonant letter in the name is not followed by a vowel letter, its existence is ignored.

After that, the teacher instructs students to re-represent the cacarakan script into mathematical symbols in the form of numbers, so that it relates to arithmetic and number material. The results of the mathematical representation are then applied to calculate the name of each student independently using the cacarakan script naktu by adding up the elements one by one. Under the guidance of the teacher, students are able to complete the addition of their own names well without any significant obstacles. Then the

Table 1. *Naktu Cacarakan Script* Consonant Letters

<i>Aksara Naktu</i>	
<i>ha</i>	1
<i>na</i>	2
<i>ca</i>	3
<i>ra</i>	4
<i>ka</i>	5
<i>da</i>	6
<i>ta</i>	7
<i>sa</i>	8
<i>wa</i>	9
<i>la</i>	10
<i>pa</i>	11
<i>ja</i>	12
<i>ya</i>	13
<i>nya</i>	14
<i>ma</i>	15
<i>ga</i>	16
<i>ba</i>	17
<i>nga</i>	18

learning activity continued by grouping students in pairs between male and female students determined by the student's own wishes.

Before the activity continues, the teacher asks the paired groups to double-check with each other the count that has been done. After everything is correct, the next activity is for the teacher to direct the pair that has been grouped to add up the two names of the students who have been paired. Until this stage, there were no significant obstacles, on the contrary, students were very enthusiastic about doing activity after activity according to the teacher's direction, and the majority of students did it immediately and could not wait for the next direction.

In addition to the name component, the thing that needs to be calculated in determining the match of a pair is by summing it with the *naktu poé*. *Naktu* is not only applied to give a certain number or value for *cacarakan* characters, it is also used to give a certain number to determine the value of the day. Here is the *naktu poé* or day of the week.

Table 2. *Naktu Poé*

Name of the Day (<i>Poé</i>)	<i>Naktu Poé</i>
Minggu	(<i>Ahad</i>) 5
Senin	(<i>Senén</i>) 4
Selasa	(<i>Salasa</i>) 3
Rabu	(<i>Rebo</i>) 7
Kamis	(<i>Kemis</i>) 8
Jumat	(<i>Juma'ah</i>) 6
Sabtu	(<i>Saptu</i>) 9

The next activity the teacher directs students to add the student's name, the name of the partner, with the day of birth of both according to the time poé that has been given. At this stage there were several students who experienced problems because they did not know their day of birth. However, based on the date, month, and year of birth, the teacher helped find the student's day of birth with the help of a calendar on a smartphone. Furthermore, the activity is carried out in accordance with the instructions that have been given.

Before the student activity is resumed, the teacher provides an explanation of the formula or methods used to calculate pair compatibility, there are four ways that students can do, including the following. (1) Students must memorize the multiplication of 7, then subtract the result of the addition that has been obtained with a multiple of 7 and save the remainder of the subtraction if the remainder is between 0 and 6. (2) The result of the previous addition is divided by 7 and keeps the remainder of the division if it is between 0 and 6. (3) Subtract 7 repeatedly so that the result is between 0 and 6, or less than 7. (4) Repeating as many times as the number of results it has to the given formula and determining the final result is at a certain point or predetermined formula. The provisions referred to can be seen in Table 3.

Table 3. Specific Rules Defined

1	<i>Sri</i>
2	Lungguh
3	Dunya
4	Lara
5	Pati
6	Sri
7	Lungguh

Based on the results of interviews with informants, the rule is a rule that has been determined from generation to generation and cannot be changed, and the final result obtained after adding the predetermined times and repeatedly subtracting 7 must be left at point 3. According to the beliefs that are still closely held, if the residual result of repeated subtraction is not at point 3, it will not get goodness and blessings in establishing relationships or in households. If they want to continue, one or both of them must change or add a name so that they get 3 points after calculating with the predetermined provisions. However, the process of changing the name that will be carried out must be in accordance with the rules that have been determined and agreed upon in accordance with the beliefs adopted.

Student activities at this stage were continued at the second meeting of research data collection. In the previous meeting, after being given the rule provisions, students were given the task of trying the four methods that had been described. In this activity students are asked to communicate the results of the work they get and find. Based on the exposure of the pair groups that had previously been determined, using the four methods that had been tried by each pair of groups, the first method could be done well by 2 groups or by 40%, the second method could only be completed by one pair of

groups or by 20%, the third and fourth methods were the easiest way to be understood and completed by all groups very well, each by 100%.

In reality, out of every pair that was timed, there were 2 matched pairs and 3 unmatched pairs. But it is not a big problem for students because it can be understood by them that this is just an experiment. And from the results of mathematical communication, it can be concluded that learning with an ethnomathematics approach based on local wisdom is able to increase student learning motivation, as evidenced by the positive attitude shown by students.

Before the evaluation, without instruction from the teacher, students became enthusiastic about trying to do similar activities with other pairs, due to high curiosity and the uniqueness of cultural knowledge that students had just learned. Apart from the learning activities that have been carried out, students are also given an evaluation of the learning outcomes. This was done to strengthen the questionnaire and initial observations made. Based on the results of cognitive and affective evaluation tests given at the end of the meeting, very good results were obtained. In the cognitive domain, the basic competencies that are the objectives in this study can be achieved well as evidenced by the achievement of scores far above the KKM set at 67. As many as 80% of students exceeded the class average score with almost perfect points.

In addition, in the affective domain as measured by a questionnaire, students' motivation to learn mathematics has increased significantly compared to students' previous motivation to learn mathematics. So, based on the research results obtained, there is a significant increase in learning motivation in learning mathematics by learning using an ethnomathematics approach based on local wisdom in the area where students live on number material.

4 Conclusion

Based on the result and data analysis that has been done, it can be concluded that there are various potential traditions, customs, and culture as local wisdom owned by Cupunagara Village. One of them is about the count of *élmu palak* regarding the calculation of good days which has relevance to the science of mathematics number material, especially in the pattern of integer counting operations at the junior high school level, grade VII semester 1. After learning mathematics with an ethnomathematics approach based on local wisdom applied to VII grade students of MTs Nurul Hikmah Cupunagara, it is proven to affect students' cognitive abilities in representing culture through *cacaran* script into mathematical form as a pattern of integer counting operations. This also affects the affective domain, namely in the aspect of students' motivation to learn mathematics, which is shown by the positive attitude of students when learning mathematics, including students being more enthusiastic about learning, being encouraged to learn unique things, and having high curiosity. Students become more motivated because mathematics learning starts from local culture, so students are more enthusiastic about finding links between customs, traditions, and culture with mathematics, or vice versa, looking for things in mathematics for application in a cultural perspective in the environment that students encounter.

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