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MATH AND MATE IN JAVANESE *PRIMBON*: ETHNOMATHEMATICS STUDY

Niken Wahyu Utami[1,2], Suminto A Sayuti[2], Jailani[2]

[1]Universitas PGRI Yogyakarta, Jl. IKIP PGRI I Sonosewu No.117, Yogyakarta 55182, Indonesia
[2]Yogyakarta State University, Jl. Colombo No.1, Karang Malang, Caturtunggal, Yogyakarta 55281, Indonesia
Email: niken@upy.ac.id

Abstract

Marriage is an essential part of life for most people. In the Javanese tradition, great attention is paid to the *weton* of the couple through Javanese *Primbon*. It predicts the fate of the couple in the marriage. This prediction of the Javanese outcome after the wedding has some numerical values. Therefore, this study aims to uncover these numerical values using ethnomathematics. This research uses a qualitative method. Analyzing the Javanese *Primbon* documents is meant to explore the numerical value of Javanese people. Also, analyzing the data using the Javanese *Primbon* documents was not only based on the interpretation of the researcher but also the result of discussions with cultural and mathematical experts. This study proposes numerical values such as number bases, remainder theorem, modulo, and modulus of the congruence in formal mathematics, which is associated with matchmaking using Javanese *Primbon*.

Keywords: Ethnomathematics, number bases, remainder theorems, modulo, the modulus of congruence

Abstrak

Pernikahan adalah bagian penting dari kehidupan bagi kebanyakan orang. Dalam tradisi Jawa, perhatian terbesar diberikan kepada *weton* pasangan melalui Primbon Jawa. Hal ini dapat memprediksi nasib pasangan dalam pernikahan. Prediksi setelah pernikahan ini memiliki beberapa nilai numerik. Oleh karena itu, penelitian ini bertujuan untuk mengungkap nilai-nilai numerik tersebut menggunakan ethnomathematics. Penelitian ini menggunakan metode kualitatif. Menganalisis dokumen Primbon Jawa dimaksudkan untuk mengeksplorasi nilai numerik orang Jawa. Selain itu, peneliti juga menganalisis data menggunakan dokumen Primbon Jawa, tidak hanya didasarkan pada interpretasi peneliti tetapi juga hasil diskusi dengan para ahli budaya dan matematika. Penelitian ini mengusulkan nilai-nilai numerik seperti bilangan dasar, teorema sisa, modulo, dan modulus kongruensi dalam matematika formal, yang dikaitkan dengan perjodohan menggunakan Primbon Jawa.

Kata kunci: Etnomatematika, bilangan basis, teorema sisa, modulo, kekongruenan modulo

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Indonesia is a maritime nation with land and sea territories stretching from Sabang to Merauke. The geographical location of the country spans across a group of small islands making Indonesia a land with various ethnic and cultural characteristics (Sutarto, 2006). Culture is a phenomenon which is common in any society. Javanese has one of the most popular customs in Indonesia known for its noble character, as it is also the tradition of other Eastern religions (Ember & Ember, 2001; Hatley, 2008; Sutarto, 2006).

The Javanese culture is a well-known custom filled with mystical issues, with no scientific basis. Java's mystic beliefs came into the open since the early nineteenth century and a poem, *Serat Centhini*, composed in 1815 in the court of Surakarta, was an aspect of Java's mystic belief (Ricklefs, 2007). Based on this mystical atmosphere, the Javanese culture is less explored scientifically. However, it contains various numerical values including ancestral civilization in terms of Mathematics (Maryati & Prahmana, 2019a; Maryati & Prahmana, 2019b; Supiyati, et al. 2019; Risdiyanti & Prahmana, 2018;

Muhtadi, et al. 2017). The development of this subject started a long time in Java, although not yet to the level of formal mathematics or the Western ones.

The objects in Javanese culture contain numerical values in various forms of literature. Ambrosio and Rosa (2017) stated that the different types of culture appear in the form of the artifact, venti-fact, or socio-fact. One of the socio-fact in Javanese culture is the foreknowledge matchmaking in marriage. Moreover, it is a general fact that marriage is something special in the lives of almost every individual, and it must be well planned, including with whom to marry. Before the wedding takes place, the Javanese usually find out about their next lives after the wedding. They carry out foreknowledge matchmaking in marriage before planning the married life. The traditional Javanese elders are the ones who usually start the whole process, guided by the Javanese *Primbon*, which is a life guide used by the people in their daily activities. The Javanese *Primbon* contains the human life guidelines from the womb, birth, adulthood, and even to the day of death.

The guide namely Javanese *Primbon* contains numerical values or mathematical knowledge from Javanese people. Although, the emergence of the *Primbon* did not have any connection with the formal mathematics taught in schools. However, there is a mathematical requirement when it comes to foreknowledge matchmaking in marriage as contained in this *Primbon* and Javanese marriage customs pay attention to the counting *weton* of the couples before they get married. It is usually used to predict the fate of the couple. The exploration of these numerical values in foreknowledge matchmaking in marriage as contained in the Javanese *Primbon* is an area of ethnomathematics studies.

Ethnomathematics Studies

Tutak, Bondy, and Adams (2011) stated that the term of ethnomathematics was first introduced by D'Ambrosio in 1978 at the annual meeting of the American Association for the Advancement of Science (AAAS). Subsequently in 1985, D'Ambrosio, Gloria Gilmer and Rick Scott formed a group known as The International Study Group on Ethnomathematics (ISGEm), whose aim was to increase the understanding of mathematical practices on cultural diversity and apply the knowledge for the purpose of education and development (Tutak, et al. 2011).

D'Ambrosio (1985) stated that ethnomathematics is the mathematics which is practised among identifiable cultural groups, such as national-tribal societies, labor groups, children of a certain age bracket, professional classes, and so on. Furthermore, it defines ethnomathematics as the intersection of mathematics with the historical, cultural, and social roots of mathematic, and also that the ethnomathematics comes from the combination of two words - ethno and mathematics, where ethno denotes the socio-cultural context, and mathematics talks about mathematical knowledge such as counting, weighing, measuring, comparing, sorting, classifying, designing, and playing (Katsap, 2018). However, Rosa and Orey (2016) explained that ethnomathematics includes ideas, procedures, processes, methods, and practices that are rooted in different cultural environments. Therefore, etnomathematics is so related to mathematics and culture in the nation.

There are several ethnomathematics related to studies carried out in other countries. One of such is the study conducted by Mohamad, Adam, and Embong (2010), which discusses an ethnomathematical study on weaving among the Malay tudung Saji or food cover weavers, focussing on investigating the mathematical ideas that are relevant to the weaving techniques, framework construction, and pattern formation. On the other hands, Fonseca (2010) discusses how youth and adult educators found ethnomathematics to be a resource useful in knowing their students better and producing an improved result in mathematics, as well as in intercultural studies related to ethnomathematics. This research offers a new perspective on conceiving mathematical knowledge and practices in youth and adult education. We also discuss the dimensions of the approach of teaching and learning practices to present a reflection about the relations among youth and adult education, ethnomathematics and the search for better understanding the teaching and learning of mathematics at schools, as well as making it an inclusion project. A related study was also conducted by Pais (2011), which clarifies the positions of ethnomathematics and its implications in the recent pedagogical research in the field. Meanwhile, François and Stathopoulou (2012) present the development of the political dimension of ethnomathematics and the researchers of critical mathematics education, also explore their similarities.

In other ethnomathematics related studies, D'Ambrosio (2013) explained about the position of ethnomathematics as a theoretical framework capable of guiding practice and serving as a curriculum for different educational projects. We also explained the fact that ethnomathematics is positioned as one which centers the children in a world of social equity and justice. Also, Matang and Owens (2014) discuss the role of indigenous traditional counting systems in children's development of numerical cognition in Papua New Guinea, and then Rosa and Orey (2015) discuss the curriculum for mathematics based on literacy, matheracy, and technoracy from ethnomathematics perspective.

Considering of all these existing articles, no author has discussed foreknowledge matchmaking in marriage guided by Javanese *Primbon* (the special book from Java) which is related to mathematics learning. Therefore, the research focus on to explore the ethnomathematics value of foreknowledge matchmaking in marriage found in Javanese *Primbon*, the body of knowledge from the ethnomathematics value of foreknowledge matchmaking in marriage found in Javanese *Primbon*, and the developed learning mathematics that can be used from the Javanese *Primbon*.

METHOD

The method used in this research is a qualitative method. The purpose of research method is to reveal ethnomathematics in Javanese *Primbon*. The design of this research follows the framework of ethnomathematics study from Alangui (2010) to conduct a qualitative method through ethnomathematics in Javanese *Primbon*. The framework is presented in Table 1.

Table 1. The Framework of Ethnomathematics Study

Generic Question	Initial Answer	Critical Construct	Specific Activity
Where is it to look?	Cultural practices in a cultural context, namely the use of the Javanese *Primbon* in determining matchmaking of the couple.	Culture	Analysis of Document Javanese Primbon. Describe how were the rules of Javanese *Primbon* that were used in determining the matchmaking of the couple.
How is it to look?	Investigating QRS (Qualitative, Relational, and Spatial) aspects of the determining the matchmaking of the couple.	Alternative thinking	Determine what QRS ideas are contained in the determining the matchmaking of the couple.
What is it?	Proof of alternative concept	Philosophical mathematics	Identify criteria to justify the rules of external customs in determining the matchmaking of the couple.
What does it mean?	The significant value of culture, and mathematics	Anthropology	Describe the relationship between the two forms of knowledge (mathematics and culture). Write a new mathematical concepts found in the determining the matchmaking of the couple.

Gathering Data

To answer the research question, we analyzed the literature of Javanese *Primbon*. Analyzing the document involves activities like skimming (cursory examination), through reading, and interpretation (Bowen, 2009). The analyzed document produced data in quotations, themes or categories, and the examination, as well as the interpretation of the Javanese *Primbon* document, was carried out to obtain the scientific values in the foreknowledge matchmaking marriage and the experience after the wedding.

Interviewing informants were also carried out as supplementary data in the study. The informants are the traditional Javanese elders, who knew deeply about the Javanese tradition. During the interview, we made notes in the form of field notes and tape recorders. This interviews conducted was aimed at verifying the validity of data from the interpretation of the researcher.

The Data Analysis

This research is limited to the rules the determining the matchmaking of the couple. The data analysis technique used in this study is taxonomic analysis. The taxonomic analysis is conducted to analyze the determining of the matchmaking of the couple, and the values of school mathematics that can be taught.

RESULT AND DISCUSSION

The foreknowledge practice through Javanese *Primbon* is still a common act among the Javanese people, and it is carried out before a wedding could take place. Foreknowledge is known in Javanese as

Petung, and the real meaning of this word in English is called computation. However, *petung* in the Javanese language does not always mean computation. It means consideration in determining something.

The *weton* of the couple is critically considered in matchmaking using the Javanese *Primbon*. *Weton* is a calculation of birthdays based on days in the Javanese Calendar. *Weton* is a composite calculation of *neptu dina* and *neptu pasaran* from the two mates. *Neptu* is certain calculation numbers. Based on interviews conducted with *Mbah Cip*, one of the traditional Javanese elders:

> "*Yen cara niki lho niki kula mboten ngguroni, yen ten mriki sing abot niku ana tembung geing. Geing niku netune sing siji Wage sing siji Pahing*" (The interview, 18 May 2018).

It means that consideration in matchmaking in Javanese society is not permissible for a prospective couple who have a *neptu wage* and *pahing* for the wedding.

The major consideration in matchmaking through Javanese *primbon* uses computation, and there are two types of matchmaking computations. The first one is the computation with the couple *weton*, and the other is computation with the names of the couple. This study focuses on the computation of matchmaking based on *weton* from the couple. In Javanese culture, the *weton* of the couple needs to be paid attention to before the wedding, and when it is computed, it helps to predict the fate of the couple during the wedding.

Computation in Predicting the Future of the Bride based on Weton of the Two Brides

There are many computations in predicting the future of the couple based on their *weton*. Also, this *weton* is a compilation of *dina* and *pasaran*. *Dina* (Days) is *Akad* (Sunday), *Senen* (Monday), *Selasa* (Tuesday), *Rebo* (Wednesday), *Kemis* (Thursday), *Jumuah* (Friday), and *Setu* (Saturday). Table 2 present the correlation between days (*Dina*) and *Neptu* namely *Neptu Dina*.

Table 2. *Neptu Dina*

Days	***Neptu***
Sunday	5
Monday	4
Tuesday	3
Wednesday	7
Thursday	8
Friday	6
Saturday	9

Pasaran is *Kliwon*, *Legi*, *Pahing*, *Pon*, and *Wage*. However, determine the match matching to predict the future of the couple after the wedding must be attention to the *neptu dina* and *neptu pasaran* of the bride and groom. Hence, attention must be paid to Table 3, for a proper discussion on computation in predicting the couple's future based on their *weton* (Tjakraningrat & Soemodidjojo, 2017).

Table 3. *Neptu Pasaran*

Pasaran	***Neptu***
Kliwon	8
Legi	5
Pahing	9
Pon	7
Wage	4

There are four types of the computations in predicting the future based on *weton* of couples, such as.

1. Type 1

The computation is performed by summing up of each *neptu dina* and *neptu pasaran* of both the bride and groom and then divided by 9. Then, the foreknowledge decision is made using the remaining value after the division. Therefore, the conclusion is based on the meaning shown on Appendix: The Meaning of the Remain Type 1, and the part of it shown in Table 4.

Table 4. The Part of the Meaning of the Remainder in Type 1

Remainder	**and**	**Remainder**	**Meaning**
4		4	*Kerep lara* (often sick)
4		5	*Akeh rencanane* (many plans)
4		6	*Sugih rejeki* (lots of luck)
4		7	*Mlarat* (poor)
4		8	*Akeh pengkalane* (many obstacles)
4		9	*Kalah siji* (One loses)
5		5	*Tulus begjane* (have continuous luck)
5		6	*Cepak rijekine* (easy of fortune)
5		7	*Tulus sandhang pangane* (have continuous prosperous)
5		8	*Akeh sambekalane* (many obstacles)
5		9	*Cepak sandhang pangane* (prosperous)

Then, after the computation, if the remainder has a good meaning, according to the Javanese *Primbon*, then the wedding takes place. However, the wedding is canceled if the result is bad.

The first example of the computation is a situation where the bridegroom is born on *Kliwon* Friday, and the bride born on *Pahing* Friday. Then, the foreknowledge of the two brides is determined by calculating the weton of each bride:

a. *Weton* of the bridegroom born on *Kliwon* Friday means: Friday = 6, and *kliwon* = 8

   Hence, the computation is $\frac{(6+8)}{9} = 1$ and the remainder is 5.

b. *Weton* of the bride born on *Pahing* Friday, means: Friday = 6, and *pahing* = 9

   Hence, the computation is $\frac{(6+9)}{9} = 1$ and the remainder is 6.

Considering the computations above with the remainders of 5 and 6, the conclusion based is based in Table 4, which is easy of fortune. In other words, if they get married, they probably have a better life, easy of fortune.

Another example is a situation where the bridegroom is born on *Kliwon* Friday, and the bride born on *Pahing* Thursday. Then, the foreknowledge of the two brides is determined as follows:

a. *Weton* of the bridegroom born on *Kliwon* Friday means: Friday = 6, and *kliwon* = 8

Hence, the computation is $\frac{(6+8)}{9} = 1$ and the remainder is 5.

b. *Weton* of the bride born on *Pahing* Thursday means: Thursday = 8, and *pahing* = 9

Hence, the computation is $\frac{(8+9)}{9} = 1$ and the remainder is 8.

From the computations, the remainders are 5 and 8. Checking these with the meanings in Table 4, we have many obstacles. In other words, if they get married, probably their life will be many obstacles.

2. Type 2

This computation in Type 2 is carried out by summing up all the *neptu dina* and *neptu pasaran* of bride and groom, then divided by 4. The foreknowledge decision in this is also made using the remaining value after the division. The conclusion of the computation based on the meaning from the Javanese *Primbon* in shown in Table 5.

Table 5. The Meaning of the Remainder in Type 2

Remainder	Meaning
1	*Gentho, larang anak* (rarely have children)
2	*Gembili , sugih anak* (have many children)
3	*Sri, sugih rejeki* (lots of fortune)
4	*Punggel, mati siji* (one died)

The first example here is a situation in which the bridegroom is born on *Kliwon* Friday, and the bride is born on *Pahing* Friday. Then, the foreknowledge of the couple is determined as follows: *Weton* of the bridegroom born on *Kliwon* Friday means Friday = 6, and *kliwon* = 8, and then *weton* bride *Pahing* Friday, means Friday = 6, and *pahing* = 9. Hence, the computation is $\frac{(6+8)+(6+9)}{4} = 7$, while the remainder is 1.

Since the remainder is 1, the conclusion of the computation as shown from the meaning in Table 5 is rarely have children. Therefore, in a situation where the bridegroom is born on *Kliwon* Friday and the bride born on *Pahing* Friday, there is no good future for them.

The second example is a situation where the bridegroom is born on *Kliwon* Friday, and the bride born on *Pahing* Thursday. Then, the foreknowledge of the couple is determined as follows: *Weton* of the bridegroom born on *Kliwon* Friday, means Friday = 6, and *kliwon* = 8, and the *weton* of the bride born on *Pahing* Thursday, means Thursday = 8, and *pahing* = 9. Hence, the computation is $\frac{(6+8)+(8+9)}{4} = 7$ and the remainder is 3.

The conclusion with the remainder of 3 as shown from the meanings in Table 5 is lots of fortune. Based on this, the bridegroom born on *Kliwon* Friday with the bride born on *Pahing* Thursday has a good future, lots of fortune.

3. Type 3

Predicting the future with Type 3 is similar to Type 2, which involves summing up of all *neptu dina* and *neptu pasaran* of bride and groom. However, the divider is 10 or 7, and the remainder of the division starting from 1 to 7. Then, the conclusion is drawn from the meanings of the Javanese *Primbon* shown in Table 6.

Table 6. The Meaning of the Remainder in Type 3

Remainder	Meaning
1	*Wasesasegara, kamot, jembar budine, sugih pangapura gedhe prabawane* (easy to forgive, accept suggestions)
2	*Tunggaksemi, cepak rijekine* (lots of luck, lots of friends)
3	*Satriya wibawa, oleh kamulyan lan laluhuran* (authoritative, noble)
4	*Sumursinaba, dadi pangungsening kapinteran* (smart, as a questioned person, a source of knowledge)
5	*Satriyaning, nandhang dukacita, kawirangan, isarat panulake ngetokake getih, umpamane mbleh ayam* (hit by disaster, affected, miserable)
6	*Bumikapetak, petengan aten, nanging taberi ing gawe, kuat nandhang lara lapa, resikan, isarat panulake mendhem lemah* (diligent work but miserable)
7	*Lebu katiup angin, nandang papa cintraka, kabeh karepe ora dadi, kerep ngalih omah, isarat panulake gabul-abul lemah* (the desires do not come true, often move home, miserable)

Like the first example in Type 2, the bridegroom is born on *Kliwon* Friday, and the bride born on *Pahing* Friday. *Kliwon* Friday means Friday = 6, and *kliwon* = 8, and *Pahing* Friday means Friday = 6, and *pahing* = 9. Hence, the computation is $\frac{(6+8)+(6+9)}{10} = 2$ and the remainder is 10 (should not). But when 7 is used, we have $\frac{(6+8)+(6+9)}{7} = 4$ and the remainder is 1.

Based on this, the conclusion is drawn from the meanings in Table 6. Since the remainder is 1, it is easy to forgive, accept suggestions. In other words, a bridegroom born on *Kliwon* Friday will have a good future with a bride born on *Pahing* Friday.

Also, just like the second example in Type 2, the bridegroom is born on *Kliwon* Friday, and the bride born on *Pahing* Thursday. *Kliwon* Friday means Friday = 6, and *kliwon* = 8, and *Pahing* Thursday means Thursday = 8, and *pahing* = 9. Hence, the computation is $\frac{(6+8)+(8+9)}{10} = 3$, while the remainder is 1. Checking for this remainder with the meaning shown in Table 6 gives easy to forgive, accept suggestions. Therefore, it is concluded that the bridegroom born on *Kliwon* Friday will have a good future with a bride born on *Pahing* Thursday.

4. Type 4

The computation of Type 4 is the same with type 2 and 3, with the summing up of all *neptu dina* and *neptu pasaran* of bride and groom. However, the divider is 5, and the remainder of the division starts from 1 to 5. Then, the conclusion is drawn from the meanings shown by Javanese *Primbon* in Table 7.

Table 7. The Meaning of the Remainder in Type 4

Remain	Meaning
1	*Sri* (noble)
2	*Dana* (charity)
3	*Lara* (sick)
4	*Pati* (die)
5	*Lungguh* (possess a position)

Like the first example in Type 2 and Type 3, the bridegroom is born on *Kliwon* Friday, and the bride is born on *Pahing* Friday. *Kliwon* Friday means Friday = 6, and *kliwon* = 8, and *Pahing* Friday means Friday = 6, and *pahing* = 9. Hence, the computation is $\frac{(6+8)+(6+9)}{5} = 5$ and the remainder is 4. Based on the remainder, which is 4, and checking it with reference to the meanings shown in Table 7, it is *pati*, meaning died. Therefore, it is concluded that the bridegroom born on *Kliwon* Friday will have bad marriage experience with the bride born on *Pahing* Friday.

Also, like the second example in Type 2 and Type 3, the bridegroom is born on *Kliwon* Friday, and the bride is born on *Pahing* Thursday. *Kliwon* Friday means Friday = 6, and *kliwon* = 8, and *Pahing* Thursday means Thursday = 8, and *pahing* = 9. Hence, the computation is $\frac{(6+8)+(8+9)}{5} = 6$ and the remainder is 1.

Considering the remainder, which is 1, the conclusion is drawn from the meanings shown in Table 7, and this is noble. Therefore, there is a good future between the bridegroom born on *Kliwon* Friday and the bride born on *Pahing* Thursday. If they get married, probably they will be very rich.

Considering this foreknowledge presented above, we could deduce that the results are inconsistent. However, the focus is not to discuss these inconsistencies; it is an indication that foreknowledge is someone's estimate, which is not necessarily true — nevertheless, it showed that numbers have a mystical aura for the Javanese and this does not only occur in Java. There was a pair of friendly numbers in the ancient Greeks, which attained a mystical aura, and superstition. Then, it later maintained that two talismans bearing these numbers would have a perfect friendship. According to Eves (1969), these numbers came to play an essential role in magic, sorcery, astrology, and the casting of horoscopes.

Relating Mate and Mathematics

The act of getting a mate and the prediction of future based on the *weton* of the couples through Javanese *Primbon* has a numerical value within the Javanese community. These computations in predicting the future have similarities in the case of repeating numbers. Ascher (1991) stated that numbers are only names given for the series formed, and the capacity to calculate is universally related to human language. Furthermore, when writing or naming numbers for each culture, it may be different from what it means in the other culture (Van Maanen, 2011; Abdullah, 2017). However, numbers usually have patterns and have implicit relationships in arithmetic.

In addition, Eves (1969) states that the calculation process must be systematized in a number base. Human fingers are more comfortable to use. Hence, it was not surprising that base 10 was chosen. Besides base 10, Eves (1969) suggests the use of 2, 3, and 4 as number bases. In line with this, certain tribes of Tierra del Fuego have several first number names based on 3, and some South American tribes also use 4. Eves (1969) also suggests that base 5 could be used extensively. There are some South American tribes that currently count by hands, such as "one, two, three, four, hands, hands and one,." Yukaghir Siberia uses a mixed scale by counting "one, two, three, three and one, five, two three, one more, two four, ten with one missing, ten."

Like calculations from other cultures that use bases, computation in predicting the future of couples based on *weton* also uses number bases. If we look at Type 1, foreknowledge used base number 9, Type 2 used base number 4, foreknowledge in Type 3 used base number 7, and Type 4 used base number 5. This shows that the computation in predicting the future of couple based on their *weton*, use different number bases for different types. In other words, Javanese *Primbon* recognizes more than one base.

Moreover, calculating through Javanese *Primbon* could be performed using other mathematical elements, as we could symbolize the calculation on Type 1 in the formal mathematical sentence. If *neptu dina* of the bride is symbolized as a, and *neptu pasaran* of the bridge is symbolized as b, and divisor 9 is symbolized in q, and the remainder of this calculation is symbolized by r, then it can be written as:

$$\frac{a+b}{q} \text{ and remainder } r, \text{ where } a = \{3,4,5,6,7,8,9\} \text{ and } b = \{4,5,7,8,9\}.$$

Also, we also could symbolize the calculation in Type 2, 3, and 4 in the formal mathematical sentence. If *neptu dina* of the bride is symbolized as a, *neptu dina* of the groom is symbolized as b, *neptu pasaran* of the bride is symbolized as c, *neptu pasaran* of the bride is symbolized as d, and the divisor is symbolized in q, and the remainder of the calculation is symbolized as r, it can be written as:

$$\frac{a+b+c+d}{q} \text{ and remainder } r, \text{ where } a = c = \{3,4,5,6,7,8,9\} \text{ and } b = d = \{4,5,7,8,9\}.$$

In the general form, the result of the sum is symbolized as a then divided by b and remainder r or written as $a = bq + r$. This is referred to as the remainder theorem in formal mathematics. In other words, one of the mathematical elements in the foreknowledge is a remainder theorem.

According to Nagell (1952), in the remainder theorem, if a and b are integers and $b \neq 0$, a unique integer q exixts such that

$$a = bq + r, \text{ where } 0 \leq r < |b|.$$

This theorem is also known as the division algorithm (Fine & Rosenberger, 2007). We take the following examples of the division algorithm:

(i) 22 divided by 5 is 4, remainder 2, so we can write $22 = 5 \cdot 4 + 2$

(ii) 26 divided by 4 is 6, remainder 2, so we can write $26 = 4 \cdot 5 + 2$

(iii) 28 divided by 3 is 9, remainder 1, so we can write $28 = 3 \cdot 9 + 1$

Another commonly used notation is $a \; mod \; m \; = \; r$ (read "a modulo m"), which denotes that r is the remainder obtained when a is divided by m. Suppose that a is an integer and m is an integer more than 0, hence:

$$a \; mod \; m \; = \; r, \text{ so that } a \; = \; mq \; + \; r, \text{ where } 0 \; \leq \; r \; < \; m$$

We can take the following examples of the modulo arithmetic:

(i) $22 = 5 \cdot 4 + 2$ is $22 \; mod \; 5 = 2$

(ii) $26 = 4 \cdot 5 + 2$ is $26 \; mod \; 4 = 2$

(iii) $28 = 3 \cdot 9 + 1$ is $28 \; mod \; 3 = 1$

Furthermore, the mathematical element in the foreknowledge is a **congruent modulo** n. In the definitions and fundamental properties, let n be an integer ≠0. The integers a and b are said to be congruent modulo n, or for the modulus n, when their difference $a - b$ is divisible by n. To express this mathematical element:

$$a \equiv b(mod \; n),$$

Where the symbol ≡ is to be read “is congruent to” , and the number n is the modulus of the congruence (Nagell, 1952). We take the following examples of the congruent modulo:

(i) $22 \; mod \; 5 = 2$ and $17 \; mod \; 5 = 2$, so $22 \equiv 18(mod \; 5)$

(ii) $26 \; mod \; 4 = 2$ and $30 \; mod \; 4 = 2$, so $26 \equiv 30(mod \; 4)$

(iii) $28 \; mod \; 3 = 1$ and $25 \; mod \; 3 = 1$, so $28 \equiv 25(mod \; 3)$

Therefore, we could conclude that foreknowledge computations contain mathematical elements including number bases, remainder theorem, modulo, and modulus of the congruence.

Proposed a Mate in Javanese Primbon as a Contextual for Teaching Mathematics

A mate in Javanese *Primbon* is a contextual problem for Javanese students. Learning uses a context that can provide comprehensive understanding and links to students to provide direct experience with hands-on experience in real life. Cultural context issues can be used in learning through ethnomathematical problems. Hence, mate or foreknowledge matching in Javanese *Primbon* can be used as an ethnomathematical problem. Ethnomathematics problems are mathematical problems in which verbal texts use narration to describe mathematical practices that exist in daily habits, traditions, and experiences of various socio-cultural groups, and solution to the problem must be examined in its social context (Katsap & Silverman, 2016; Risdiyanti & Prahmana, 2018).

Problem’s text using ethnomathematics can be built by integrating problems related to a culture which contain mathematical content. Katsap and Silverman (2016) argue that the problem contains two parts; the first part contains a prelude, which is a segment of information related to the culture, tradition, or habits of society. The second part of the problem’s text contains mathematical questions (the solution

is discussing mathematical objects and structures requires investigation or evidence) and non-mathematical questions (referring to social problems or facilitating mathematical practices in the community). Here is an example.

Problem: Prediction of fate marriage through base and modulo

Read the prelude before you answer the following questions.

Prelude

In the tradition of marriage in Javanese, various things need to prepare, including determination about the compatibility of the two brides. Traditional Javanese elders usually do match matching between the two brides. The determination of the compatibility of the two brides contains predictions about life later after marriage based on the *weton*. If the foreknowledge results are good, then the determination continues on the search for a good wedding day for the bride and groom. However, if the foreknowledge results are not good, the marriage of the two brides will not take place.

The task

1. Describe in your own words what you've learned about the rural setting of the prediction of fate marriage from the prelude information.
2. A girl of sufficient marriage (a mature woman), has Tuesday *Legi weton*. The girl's parents looking for a partner to her daughter. If the forecasting used is to use the modulo base 4, the computation is carried out by summing up all the *neptu dina* and *neptu pasaran* of bride and groom, then divided by 4. Then, the foreknowledge decision is use Table 8. Furthermore, find *weton* of a man, who has a good prediction if he is married to the girl.

Table 8. The Meaning of the Remainder in Modulo 4

Remainder	Meaning
1	*Gentho, larang anak* (rarely have children)
2	*Gembili , sugih anak* (have many children)
3	*Sri, sugih rejeki* (lots of fortune)
4	*Punggel, mati siji* (one died)

CONCLUSION

The use of Javanese *Primbon* in marriage is something unique in predicting the future. We have shown that matchmaking of mates using foreknowledge through Javanese *Primbon* is attributed to number bases, remainder theorems, modulo, and modulus of congruence in formal mathematics. Hence, the matchmaking of mates using foreknowledge through Javanese *Primbon* has potential material as a context in mathematics learning, such as the context in making an ethno-mathematical problem. The limitation of this study is needed to be continued for further research on its empirical use in mathematics learning by the topic.

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Appendix: The Meaning of the Remain Type 1

(Source: Document of Javanese *Primbon*)

Wetoné pangantèn lanang lan wadon, neptuné dina lan pasaran digunggung, banjur kabagé 9, lanang turah pira, wadon turah pira :

Yèn turah :

1 lan 1. becik kinasihan
1 " 2. becik
1 " 3. kuat, adoh rijekiné
1 " 4. akèh bihahiné
1 " 5. pegat
1 " 6. adoh sandhang pangané
1 " 7. sugih satru
1 " 8. kasurang - surang
1 " 9. dadi pangauban
2 " 2. slamet, akèh rijekiné
2 " 3. gelis mati siji
2 " 4. akèh godané
2 " 5. akèh bilainé
2 " 6. gelis sugih
2 " 7. anaké akèh mati
2 " 8. cepak rijekiné
2 " 9. akèh rijekiné
3 " 3. mlarat
3 " 4. akèh bilainé
3 lan 5. gelis pegat
3 " 6. olèh nugraha
3 " 7. akèh bilahiné
3 " 8. gelis mati siji
3 " 9. sugih rejeki
4 " 4. kerep lara
4 " 5. akèh rencanané
4 " 6. sugih rejeki
4 " 7. mlarat
4 " 8. akèh pangkalané
4 " 9. kalah siji
5 " 5. tulus begjané
5 " 6. cepak rijekiné
5 " 7. tulus sandhang pangané
5 " 8. akèh sambékalané
5 " 9. cepak sandhang pangané
6 " 6. gedhé bilahiné
6 lan 7. rukun
6 " 8. sugih satru
6 " 9. kasurang - surang
7 " 7. ingikum maring rabiné
7 lan 8. nemu bilahi saka awaké dhéwé
7 " 9. tulus palakramané
8 " 8. kinasihan déning wong
8 " 9. akèh bilahiné
9 " 9. giras rijekiné

Katrangan : Saupama wetoné pangantèn lanang Jumuah Kliwon neptuné 6 + 8 = 14 kabagé 9, turah 5. Wetoné pangantèn wadon Jumah Paing, neptuné 6 + 9 = 15, kabagé 9, turah 6. Dadi 5 + 6 tiba cepak rijekiné, iku becik.