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## ETHNOMATHEMATIC EXPLORATION IN THE ART OF MALANGAN MASK PUPPETRY

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### ABSTRACT

Malang Regency's mask art is a typical East Javanese tradition that is rich in cultural and artistic dignity. However, its existence is currently increasingly threatened due to minimal attention from the public and lack of research on mask art. This research aims to explore the material assemblages and relationships in Malang Regency mask art because it can provide new insights into how mathematics can be integrated into local culture. In addition, research contributions help to preserve mask art and increase public awareness of Javanese cultural values and philosophy in wayang masks. The method used in qualitative research is ethnographic type. The key instrument consists of two resource persons consisting of 1 resource person as a studio owner and performer of the art of masked wayang and 1 resource person as a mask craftsman. Data collection techniques through interviews, observations and documents. The discussion stage resulted in an exploration of the concept of sets and relationships that can be found from the characteristics of wayang mask art. Thus, research exploring ethnomathematics concepts in Malang Regency mask art can enrich mathematical knowledge applied in the local cultural context.

**Keywords:** Art of Masks, Ethnomathematics, Associations, Relations

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### PRELIMINARY

Mathematics is influenced by aspects of the historical, ecological, social, geographical, and cultural life of man. Prahmana & D'Ambrosio (2020) disclose that draft mathematics appears from the method man reacts to the environment, like when looking for an explanation, understanding, and searching for solutions to various phenomena. Next, the concept of mathematics is very near to the culture local in life every day (Prahmana et al., 2021). Pathuddin (2023) also added that values and culture own very role significant as indicator characteristics of something great nation proven by the existing draft culture there is in learning mathematics or called with ethnomathematics.

According to D'Ambrosio (Shannon, 2021), ethnomathematics is a method for learning and combining existing ideas, methods, and techniques used and developed by social cultures or members of different cultures. Ethnomathematics tries positioning repeat, math must rooted in different cultures, accommodating different ideas so that students become reasoner critical, democratic, and tolerant (Wiryanto et al., 2022). In inactivity ethnomathematics, someone can count, observe, measure, classify, create tools or design buildings, look for a functional model, and so on (Fauzi & Lu'luilmaknun, 2019). In a study, object inherited material is a representation of the art of masks special related to identity group culture typical area East Java.

The mask becomes wisdom culture in local areas spread across the islands of Java and Bali. The distribution of Balinese masks has an abstract shape so that esthetic and frequent appearance combine elements of animals and patterns of plants, decorated with colors red, yellow, green, and gold that reflect the life of Balinese art (Putra et al., 2020). Mask art on the island of Java originates from West Java, namely Cirebon masks, and from East Java. Cirebon masks have characteristics from replicating faces of man in a way accurate and ornate made of material hair bird or jewelry metal (Ah et al., 2021). Meanwhile, masks from East Java known as the Malangan mask have characteristics typical of the mask's face appearing more real accompanied by more color diverse that is color red, white, yellow, green, and black can show in show masked puppets.

Masked puppets become part important from the identity culture of East Java. Art this a means to disclose characteristics unique from each mask. A masked puppet that isn't only just entertainment, but utilized as a tool communication for to convey the message how wisdom life to the public (Yanuartuti et al., 2021). So Malangan mask puppetry's connection tightly with the method of thinking in looking at reality life around.

Based on the observation of the results, art-masked puppets are displayed with renditions of gamelan dances and songs story Panji (Fitriyani et al., 2019). We can see the wisdom of culture locally expressed through conversation between characters and plays played. The conversation is delivered from politeness (politeness in speaking), subasita (politeness), and moral messages (Risdiyanti & Indra Prahmana, 2020). Puppet masks also have a protagonist, antagonist, antagonist and many again (Guntur, 2021). Scene opening masked puppets are marked with line kedhaton (state place). Then adalang (puppeteer) introduces paraga (character) when conflict appears and ends with a solution.

Form character puppets reflected through movement dance and dialogue acted by puppeteers. Malangan mask pattern usually covers the over-face dancer that obstructs the

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dancer from speaking. Mask characters are utilized in staging puppet use game or play certain. In the show There are masked puppets in Malang story journey figure Panji original East Java in the period X to XIII centuries (Tayibnapis et al., 2022). Characteristic features figure in play puppet masks are expressed in the form of mask carvings, depicting warriors from Clan Sewandana, Panji Asmarabangun, Gunungsari, Bapang, Ragil Kuning, Dewi Sekartaji and Sabrang (Suprihatin & Pratomawati, 2019). Honor and dignity stated in masked puppets are representation symbolic comparing the behavior of "Java", which is considered as an act in demand refined, and the behavior of "Sabrang", is seen as an expression of behavior outside society Java is possibly considered to bother peace public (Widiyanto et al., 2018).

A study related to the art of masks has been done by several researchers previously among them (Nisa, 2019) research draft geometry on the Malangan mask. Furthermore, a study implemented by Ah dkk (2021) researched Cirebon masks with a golden ratio approach. Then research was also carried out by Prahmana & Istiandaru (2021) draft set in Wayang skin. So, there are differences in research This with study of Other ethnomathematics, namely lift art the Malang mask puppet (Bapang mask) which contains draft mathematics on patterns characteristics of the character.

The objective study this to explore Malangan mask puppetry related to element mathematics that has been studied in a way autodidactic by society, as well as benefit ethnomathematics in the learning process. Besides that, you can see that puppet masks have draft mathematics in matter method mastermind apply classification based on character puppets totaling 76 characters, so become point beginning for study about sets and relations (relationships).

Therefore ethnomathematics can become the right means for learning and understanding the tradition of the people of Malang through the art of the mask. This matter can open awareness among students and will be importance in learning how mathematics influences culture and traditions in Indonesia. Besides that, learning-based ethnomathematics can integrate environment culture with concepts of mathematics, so participants educate more appreciate, and appreciate the culture around them.

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## **METHODS**

Use method research that used qualitative with type study ethnographic. This matter is in line with the approach of ethnomathematics, which aims to explore ideas, methods, and practices of mathematics, as well solution problems caused by members' culture and moral values (Ekowati, 2017). The subject study is two skilled people making masks and puppeteering puppet masks. Subjects were chosen using purposive sampling with criteria 1) understanding mask size; 2) moment study was done, craftsman currently does mask sculpting; 3) the subject including the puppeteer in the mask puppetry so understand characteristics of each group figure. According to criteria the, the subject is the first 28 years old and the subject second 45 years old whose address is Jalan Warrior Slamet Rt. 17 Kedungmonggo Hamlet, Village Karangpandan, District Pakisaji, Malang Regency. Data is collected through observation, documentation, and interviews. The interview was done in a form that is not structured, with a guide general. Questions more detailed developed based on answers given by respondents.

The qualitative data analysis process covers step data reduction by classifying character-masked puppets divided into 4 groups of characters after carrying out data collection. Furthermore, the step presentation of data viz classification group character masked puppets are arranged in form chart in a way systematic and easily understood. The final step withdrawal conclusion aims to look for the meaning of the data collected by describing art puppet masks have a connection with draft mathematics on the material sets and relations.

## **RESULTS AND DISCUSSION**

### **a. Philosophy Java Art Mask Puppet**

Puppet Mask is one performance involving players wearing masks to describe characters in a story such as kings, soldiers, and figures of mythology. The story is Mahabharata, Ramayana or Panji. The original mask dance originated from the Kediri kingdom led by a king named Airlangga or Resi Jatayu, which also developed in the region (duchy) of Tumampel by Tunggal Ametung, next became a forerunner will kingdom Singosari in the Singosari area mask dance experience development.

Initially, masks were used as a means of internal ritual events. Hinduism is a developing religion in the rapid era of the kingdom Majapahit, in fact automatically the mask also experiences development as one of the forms of dance. As Islam entered Indonesia in line with the collapse kingdom Majapahit, during the era Sunan Bonang and Sunan Kalijaga

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mask dance experienced development more fast. The mask puppet took characterization from stories of Mahabharata, and Ramayana, as well as stories or plays of Panji and Menak. After Sunan Bonang and Sunan Kalijaga died, the mask danced like a sink. Surya Atmojo, the previous one working at the Palace Majapahit, fled self to the Malang area with masks and the ability to dance. He then served as aide main or assistant regent first in Malang Regency. Regent is interested in Surya Atmojo 's expertise as a deep mask dancer and a show puppet, which is at the end set mask as characteristic of typical Malang culture.

Based on structure the story is, Malangan masked wayang served with a number of character in show the play. Character Wayang Mask contains 76 characters with distribution that is character first is figure good called with figure Panji there are 26 characters, characters second is figure wicked called figure sabrang there are 31 characters, characters third is figure servant can called servant or village headman men, and emban For woman there are 13 characters, and the last is figure animal there are 6 character . Puppet with good character own different visual characteristics with those who have character bad , character servant nor figure animal. Although some masks perhaps own character mixed, us still can with easy differentiate characteristics original from doll because they show different visuals. Characters in masked puppets can seen in code as following;

**Table 1. Character Names Malangan Mask Puppet**

1. Panji Laras	20. Panji Lembu Amiluhur
2. Dewi Sekartaji	21. Udatapi Kartolo
3. Dewi Ragil Kuning	22. Panji Amiseno
4. Dewi Kili Suci	23. Panji Amiseni
5. Dewi Tajeswara	24. Panji Pambelah
6. Dewi Walangwati	25. Panji Panggending
7. Panji Walangsemirang	26. Panji Pamecut
8. Raden Gunungsari	27. Panji Anom
9. Raden Kudanawaransa	28. Panji Amerdadu
10. Raden Tanjung Seto	29. Panji Banyaksasi
11. Raden Parang Teja	30. Panji Kudanawarsa
12. Klono Sewadana	31. Patih Carang Lampit
13. Klono Garuda Lelana	32. Patih Kollo Memreng
14. Bapang Jaya Sentika	33. Patih Dandang Mangku Praja
15. Bapang Jaya Pangangun	34. Patih Kraeng Raja
16. Patih Kollo Dinemprang	35. Patih Gurawangsa
17. Patih Ngaronggo Kusuma	36. Patih Musing Jawa,
18. Panji Asmara Bangun	37. Brajanata
19. Panji Lembu Amijaya	38. Patih Kollo Renggut Muka

39. Klono Baron Sakeber	58. Bilung
40. Lembu Sura	59. Raden Patrajaya
41. Lembu Gumirang	60. Demang Mones
42. Patih Sura Dwipangga	61. Demang Mundu
43. Patih Dandang Mangkurat	62. Demang Tirtoyudo
44. Patih Gajah Mero	63. Bambang Painem
45. Patih Gajah Suba	64. Emban Dewool
46. Patih Lindu Sekti	65. Emban Ono Ini
47. Patih Talang Segara	66. Jarodeh
48. Wadal Werdi	67. Prasonto
49. Totok Kerot	68. Celeng Srenggini
50. Buto Terong	69. Laler Ijo
51. Betara Kollo	70. Nogo Timur
52. Kollo Tekik Sologonjo	71. Bader Bang
53. Kollo Murko Mamang	72. Bedes
54. Mahesa Suro	73. Wahmuka
55. Bagawan Walang Dewa	74. Rohmuka
56. Begalan Gajah Abuh	75. Pinggir Muka
57. Narada	76. Hermuka

### 1. Character Figure Good

Character figure Good called figure Panji has traits good to humans. Characteristics figure Panji as the protagonist in the story is marked with a bright face, showing a characteristic good heart. Shaped eyes paddy symbolizes honesty, patience, dexterity, and heroism. Her little lips open showing his nature is gentle and virtuous sublime. The point yellow in between the eyebrows symbolizes origin suggesting the lord His eyebrows rarely, the nose sharp, mustache often decorated decoration flowers, leaves, and tassels on carvings the mask as characteristic of Budi's good character.

### 2. Character Figure Wicked

The character figures wicked or antagonist called with figure Sabrang owns it traits bad for humans. Characteristics typical of figure Sabrang such as his big eyes, nose shape the pig, its sinusoidal mouth, the beard that resembles bush thorns jasmine, and his distinctive beard placed making beer. His face is red, which indicates his character is angry and brave.

### 3. Character Figure Servant

The character figure servant called Abdi's character owns it traits humorous in humans. Characteristics of the characters servants, have thin eyebrows, wear closed heads/udeng, and are colored bright.

#### 4. Character Figure Animal

Character figure animal related animals with natural how to teach man For guard natural covers plants and animals because natural is source life.

##### b. Draft Set in Character Mask Puppet

After researching cultural puppet masks using an approach to ethnography, discovered that during the show of puppet masks, the puppeteer arranges character who uses draft sets following ideas, methods public local, and technical lowered from time to time. Besides that, we also found the philosophy of life, moral rules, and strategy in the show mask puppet about the connection between the creator, humans, and nature around us. This matter can be found in every story and appearance of masked puppets. Therefore for Indonesians, includes wayang mask complex art with mark high art and influence significant to life public. A set that contains all defined object called set universe as following :

##### 1. Set Universe

Mastermind gathers figure masked puppets are necessary noticed provision characters good, characters bad, characters servants, and characters animal will risky in define elements set as described descriptions the character. With so, the character can be easily avoided in a defined set. A set that contains all defined objects is called a set universe. So when the mastermind groups all the puppets in a story, he in a way not directly use draft set deep universe form mathematics can be symbolized as following.

Set universe Malang mask figure = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76}.

We can too introduce a notation set. For example, S states set all figure Malang mask puppetry, we can state set This become notation set as following.

$$S = \{x|x \text{ Malangan Mask Figure}\}$$


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**Figure 1. Puppet Mask Characters**

## 2. Set Part

Furthermore member figure Panji, figure sabrang, figure servants, and figures animal can seen from illustration each character.

- a. Figure Panji is bunch puppet with character Good. its members consists of 26 figures that is codes 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 44 , 45. Set figure Panji can stated in mathematics as following.

Figure Panji = {Panji Asmara Bangun, Panji Lembu Amijaya, Panji Lembu Amiluhur, Panji Amiseno, Panji Amisani, Panji Pambelah, Panji Panggending, Panji Pamecut, Panji Anom, Panji Amerdadu, Panji Banyaksasi, Panji Kudanawarsa, Panji Laras, Dewi Sekartaji, Dewi Ragil Kuning, Dewi Kili Suci, Dewi Tajeswara, Dewi Walangwati, Dewi Walang Semiring, Raden Gunungsari, Raden Raden Kudana Warawangsa, Raden Tunjung Seto, Raden Parang Teja, Panji Gurawangsa, Brajanata, Raden Pratajaya}.

For example, A states member figure ensign, us can state draft set to in notation as following .

$$A = \{x \in S | x \text{ is a member of the Panji character}\}$$





**Figure 2. Good Character**

- b. Figure sabrang is bunch puppet with character wicked. Its members consists of 31 figures that is codes 1, 6, 27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 39, 40, 41, 42, 44, 46, 47, 48, 50, 51, 52, 53, 54, 73, 74, 75, 76. Set figure Panji can stated in mathematics as following .

Characteristic Sabrang = {Patih Kollo Dinemprang, Patih Ngaronggo Kusuma, Klono Sewadana, Klono Garuda Lelana, Bapang Jaya Sentika, Bapang Jaya Pangangun, Klono Baron Sakeber, Lembu Gumirang, Patih Sura Dwipangga, Patih Dandang Mangkurat, Patih Gajah Mero, Patih Gajah Suba, Patih Lindu Sekti, Patih Carang Lampit, Patih Kollo Memreng, Patih Dandang Mangku Praja, Patih Kraeng Raja, Patih Gurawangsa, Patih Musing Jawa, Patih Kollo Renggut Muka, Patih Talang Segara, Wadal Werdi, Buto Terong, Betara Kollo, Kollo Tekik Sologonjo Kollo Murko Mamang, Mahesa Suro, Wahmuka, Rohmuka, Pinggir Muka, Hermuka}

Example  $B$  stating the members of the Panji figure, we can express the concept set to in notation as following .

$$B = \{x \in S | x \text{ is a member of Sabrang}\}$$



**Figure 3. Evil Characters**

- c. Figure servant is bunch puppet with character servant. its members consists of 13 figures that is code 49, 55, 56, 57, 58, 60, 61, 62, 63, 64, 65, 66, 67, such as seen in Figure 3.

Characteristic supporting = {Totok Kerot, Bagawan Walang Dewa, Begalan Gajah Abuh, Narada, Bilung, Demang Mones, Demang Mundu, Demang Tirtoyudo, Bambang Painem, Emban Dewool, Emban Ono Ini, Jarodeh, Prasonto}

Example *C* stating the members of the Panji figure, we can express the concept set to in notation as following .

$$C = \{x \in S | x \text{ is a member of the abdi figure}\}$$



**Figure 4. Supporting Characters**

- d. Figure animal is bunch puppet with character animal. It's members consists of 6 figures that is codes 70, 71, 72, 33, 68, 69 like seen in Figure 4.

Characteristic animal = {lembu gumirang, buto terong, celeng srenggini,  
laler ijo, nogo timur, bedes}

Example  $D$  stating the members of the Panji figure, we can express the concept set to in notation as following .

$$D = \{x \in S | x \text{ is a member of the animal figure}\}$$



Figure 5. Animal Characters

### 3. Slice

If we own two sets. The junction set between both of them can defined as owned members of both of them. In matter This can We take an example, yes members who have characteristic hypocritical sometimes nature well and sometimes nature wicked that is codes 73, 74, 75, 76 are available in set good and evil, yes We illustrate as follows.

Characteristic hypocrite = {wahmuka, rohmuka, pinggir muka, hermuka}

Example  $E$  stating members of the nature of hypocrisy, we can state the concept set to in notation as following .

$$E = \{x \in S | x \text{ is a member of a hypocritical nature}\}$$

$$E = A \cap B = \{x | x \in A \wedge x \in B\}.$$



Figure 6. Hypocritical Character

Besides so , there are 5 characters always the main thing is in the play or story Rabine Panji , Panji Laras, and Umbul-umbul Madyopuro, so can illustrated as following .

Figure main = { Panji Asmarabangun, Dewi Sekartaji, Raden Gunung Sari, Klono Sewandono, Bapang Joyosendiko }

Example  $F$  states figure main in third story Rabine Panji, Panji Laras, dan Umbul-umbul Madyopuro so can stated in notation set as following .

$$F = \{x \in S | x \text{ is main charachters}\}$$

$F = \text{Panji Asmarabangun, Dewi Sekartaji, Raden Gunung Sari, Klono Sewandono, Bapang Joyosendiko} \cap \text{Rabine Panji, Panji Laras, dan Umbul-umbul Madyopuro}$   
 $= \{x | x \in \text{Rabine Panji} \wedge x \in \text{Panji Laras} \wedge x \in \text{Umbul-Umbul Madyopuro}\}.$



**Figure 7. Main Character**

#### 4. Complement

So from characteristic set all members of the characters masked puppets can concluded that set member figure Panji is complement from set all figure sabrang, figure servants , and figures animal .

$$\text{Figure Panji} = \{\text{figure sabrang, figure abdi, figure binatang}\}^c$$

$$\text{Figure Sabrang} = \{\text{figure panji, figure abdi, figure binatang}\}^c$$

$$\text{Figure Abdi} = \{\text{figure panji, figure sabrang, figure binatang}\}^c$$

$$\text{Figure Binatang} = \{\text{figure panji, figure sabrang, figure abdi}\}^c$$

Besides that 's us can introduce draft set blank. From membership figure Panji, figure servants , and figures animal is known that no there is figure puppetry included in third set the. Because of that,

$$A \cap D = \emptyset$$

$$B \cap D = \emptyset$$

$$C \cap D = \emptyset$$

### 5. Combined

With the use of a characteristic features set that has been defined previously, we also got it to introduce about operation set, like combined, sliced, and complementary. Clear that set all figure mask puppetry is combined from set figure Panji, figure Sabrang, figure Servants, and figures Animal. By mathematically, we can show as following.

$$\text{Himpunan tokoh wayang topeng} = A \cup B \cup C \cup D$$

Next, we can state notation unification set namely .

$$S = A \cup B \cup C \cup D = \{x | x \in A \vee x \in B \vee x \in C \vee x \in D\}$$

### 6. Relation

Draft relation is member a set can be connected with member another set or with member the same set. In story puppet mask-loading story Panji there is something wedding between Panji Asmarabangun wakes up with goddess Sekartaji, and Raden Gunungsari with Dewi Dewi Ragil Kuning. Panji Asmarabangun also has it child that is Panji Laras. Draft relation contains submaterial Cartesian multiplication. For example  $A$  and  $B$  is any non empty set. Cartesian multiplication  $A \times B$  is the set of all ordered  $[x, y]$  pairs where  $x \in A$  and  $y \in B$  then  $A \times B = \{[x, y] | \text{untuk setiap } x \in A \text{ dan } y \in B\}$ . Thus there is relation or connection in character Malang mask puppetry which can illustrated as following;

Is known set  $A = \{\text{Panji Asmarabangun, Raden Gunungsari}\}$  and set  $B = \{\text{Dewi Sekartaji, Dewi Kilisuci}\}$ . If relation from  $A$  to  $B$  is relationship "married with" then notation relation from set  $A$  to set  $B$  is

$$A \times B = \{ (\text{Panji Asmarabangun, Dewi Sekartaji}), (\text{Raden Gunungsari, Goddess Kilisuci}) \}$$

Is known set  $A = \{\text{Panji Laras}\}$  and set  $B = \{\text{Panji Asmarabangun, Dewi Sekartaji}\}$ . If relation from  $A$  to  $B$  is relationship "child from" then notation relation from set  $A$  to set  $B$  is

$$A \times B = \{ (\text{Panji Laras, Panji Asmarabangun}), (\text{Panji Laras, Dewi Sekartaji}) \}$$

## CONCLUSION

Exploration results ethnomathematics culture Malangan mask puppetry find draft base sets and relations, ie set universe, set part, combination set, slice set, complement sets, and concepts set empty, as well relation or visible relationship from arrangement puppets on characters figure. Getting started learning mathematics from the phenomenon culture around is the important thing. We can use it To reduce the gap in formal mathematics with context closest you can get understood student. With the use of context, math will be more

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interesting. Besides that culture, Indonesian masked puppets are rich in philosophy life, moral values, and views deep life, which can be used For education character students. Findings This is also an enriching development exploration ethnomathematics in culture can applied in the learning process mathematics for example for analysis ability think critical student.

Besides that, research more carry on can be carried out to study formal knowledge of the universe can start as something new. Furthermore, the results can inspire draft ethnomathematics in the arts the masked puppet introduced draft sets and relations ( relationships ) with hook examples from culture Malang Regency, so this can teach students to solve related problems with sets and relations in context can practice analysis thinking critical. Students can given challenges or scenarios involving the use set, like organizing data, completing problems, or identifying patterns in the data set. Students need to apply thinking critical to understand problems, plan approach solutions, and evaluate solutions found. Finally, the findings give promising context for study organizing and building the character of good students for study more carry on.

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