

MATHEMATICAL ELEMENTS IN MALAY TRADITIONAL GAME: A CASE STUDY ON *GASING PANGKAH*

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Abstract

This paper studies the mathematical elements in a traditional Malay game called *gasing pangkah*. A survey was conducted among 60 undergraduate students to evaluate their interests and interviews with an expert were carried out to get the insight of mathematical elements in *gasing pangkah*. The result shows that more than 50% of the students know how to play *gasing pangkah*. Only 22% of the students are interested in playing it during their leisure time, 60% are slightly interested and 18% are not interested. Mathematics concepts identified in the *gasing pangkah* game are geometry, measurement, stability on base area, projectile and weight. The mathematical practices identified are designing or creating, planning, organizing, executing, visualizing, checking, measuring, adjusting, transforming, estimating and precision. *Gasing pangkah* is an outdoor game that could help to develop social interaction, motor skills and intellect besides encouraging society to be physically active.

Keywords: Ethnomathematics, *Gasing Pangkah*, Malay Traditional Games, Mathematical Concepts, Mathematical Practices.

1. Introduction

Mathematical concepts can be defined as the idea of mathematics based on the mathematical knowledge and understanding behind the working or situation. Students who understand mathematical concepts need not memorize answers in solving mathematical problems. Nila (2008) states that learning mathematics is a necessity to inculcate the concepts to apply the knowledge in daily routine. In addition, the concepts are familiarly being applied and seen such as hunting (distance), cooking (ingredients proportion), gardening (optimization), daily spending (discount calculation), handicraft (symmetry) and many more. In solving mathematics problem, mathematical practices require students to identify and apply certain process. Mathematical practices in physical activities and crafts can be extracted as visualizing, calculating, measuring, transforming, checking, repeating and many more (Nor Maizan, 2016).

Ethnomathematics is one of the branches in mathematics that unveils the mathematical ideas hidden in our diverse culture. The term was introduced by D' Ambrosio to describe the ideas and practices of mathematics that can be found in any culture (D'Ambrosio, 1985; Ascher and D'Ambrosio, 1994; Rosa et al. 2016; Albanese and Peralese, 2015). Ethnomathematical study is used to relate the embedded mathematical ideas to understand cultures better.

Malaysia is known to be a diverse country that has various wonderful cultures and heritage from different races. Malay, Chinese, Indian and other multicultural ethnics in Sabah and Sarawak such as Dayak, Iban, Kadazan have many unique elements and values embedded in their cultural activities. These can be seen through music, arts, textile, motives design, potteries and many others (Syahirah Afiqah, 2019; Nor Maizan, 2016; Nor Maizan et al., 2012; Rokiah et al. 2010, Norwani, 2002; Siti Zainon, 2006). Traditional game is one of the identities of the country that should be preserved and proud of as Malaysian. The games like *congkak*, *batu seremban*, *sepak raga* and *wau* have been played and passed down from one generation to the next. Usually, traditional games are played during free time and there are many benefits and elements of learning that can be found in them (Noraziah and Wan Ahmad Jaafar, 2017; Ratna and Gida, 2016).

2. Significant of research

It is important to preserve the heritage of Malay traditional game, in particular the mathematical aspect which surrounds the community. Currently, the outdoor game could encourage individual to perform a healthy and physical routine as an alternative to addiction of e-gaming by school and university students. Hence, it is important to discuss this game in detail in terms of learning objectives which covered cognitive, aptitude and motor skills domains. Finally, this study is also intended to introduce and highlight the benefit of the traditional game to educators, parents and younger generations.

3. Objective of research

The purposes of this research are to:

- a) evaluate students' interest in playing traditional game, which is gasing pangkah.
- b) determine the mathematical concepts and practices in gasing pangkah game.

4. Literature review

Traditional games are normally played by the ancient people either as a hobby or in a competition. The aim of playing these games is to win the game, with some moral values of the

society that could be added. To win the games, some strategies are required (Zaslavsky, 1998). *Gasing* is a traditional outdoor game that still has a place in Malay generation today. Figure 1 (a) and (b) shows the game being played by several individuals in a competition. The game tests the players' ingenuity by looking at those who could make their top spin in the longest time (JKKN, 2018). *Gasing pangkah* is famously played in Malaysia and it is not only about spinning. The game needs a proper technique and sometimes it takes a few years to hone and improve the skills. It is played with string that spins the top for a long time. The game is played is usually played by boys aged nine and above in a group or minimum of two players. It needs certain skills to strike off the opponent's *gasing* by making it fall and stop spinning.

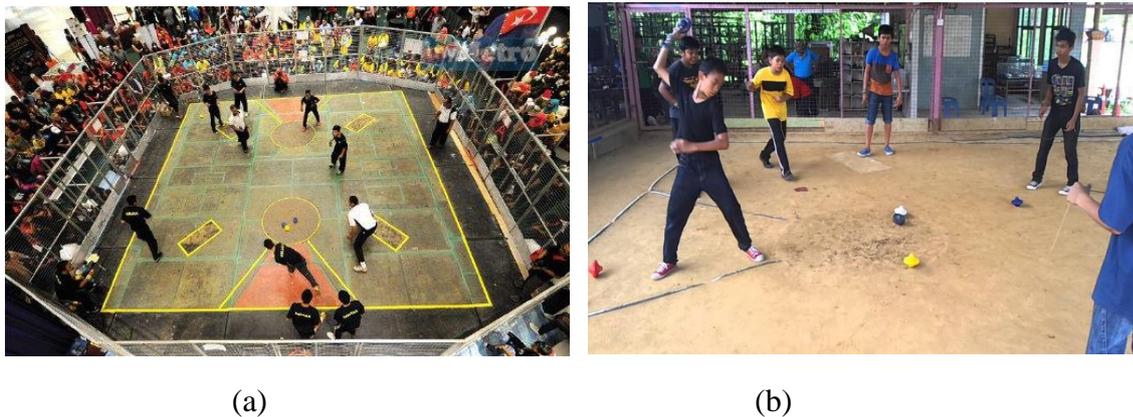


Figure 1 (a) and (b): Competition and activity of *gasing pangkah*

There are many types of *gasing* in Malaysia such as *gasing jantung*, *gasing loceng*, and *gasing leper* which is famously played in Kelantan. It is made of special wood such as *merbau*, *kempas*, *keranji* to maintain its durability. The technological development nowadays has introduced an innovation to this traditional spinning top where the wooden materials have been replaced with polymer. This innovation was introduced by University of Putra Malaysia in co-operation with organisations and enthusiast. According to them, by using this material, the durability is better, lower cost and is lighter compared to the wooden material (Laupa, 2015). Figure 2 shows the structure of *gasing pangkah*.

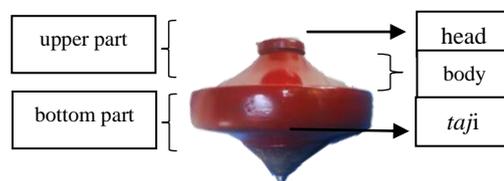


Figure 2: Structure of *gasing pangkah*
(Reference from Interviewed Player)

The court of *gasing pangkah* is as in Figure 3.

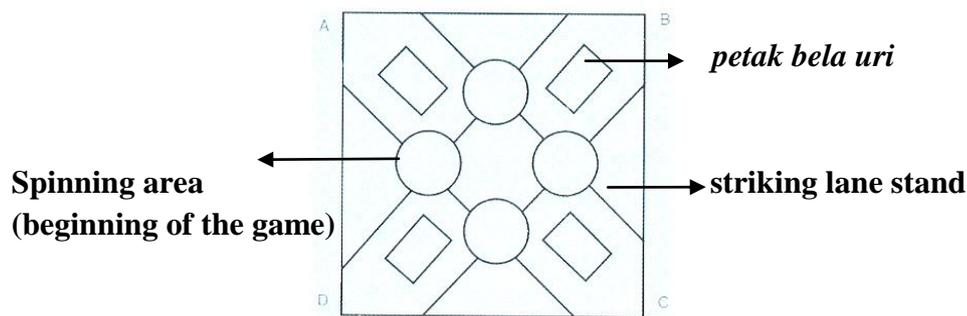


Figure 3: The shape of *gasing pangkah*'s court

Rules of the game are as follows:

- The game takes about 30 minutes.
- Time allocation is given to team setter and team strike throws and strikes their *gasing* in 10 seconds and 12 seconds respectively.
- After striking, *uri sah* (*gasing* that is still spinning after striking attempt) must be placed into their own *petak bela uri* (rectangular area on the *gasing* court) in one minute. *Gasing* for both teams must be in the game court. The team with more *uri sah* wins the match while if both teams have the same amount of *uri sah*, the spinning will continue for two minutes. The longest spinning of *gasing* will win the round. If the *gasing* is still spinning after two minutes, the round will declare as a tie.
- If team striker wins the round, three points will be given, two points if the opponent (team setter) break the rules while playing and team striker will strike again. Meanwhile, if team setter wins the round, the team will become striker for the next round.

In formal competition, *gasing pangkah* is played in a group of eight members in two teams which is called *Regu*. One of the groups is known as *pemangkah/pemunsing* (team setter) and the other group is known as *pemangkah* (team striker) with four members in a group respectively. The game can be categorized into adult, teenager and children. Table 1 shows details of player categories and measurement of *gasing* circumference, mass and height (The Ministry of Culture, Arts & Tourism of Malaysia, 1999).

Player	Circumference (cm)	Mass (gram)	Height of (cm)
Adult (above 18 years)	$36 \leq \text{circumference} \leq 46$	mass ≤ 800	$8 \leq \text{height} \leq 12$
Teenager (13- 18 years)	$36 \leq \text{circumference} \leq 46$	mass ≤ 800	$8 \leq \text{height} \leq 12$
Children (under 13 years)	$34 \leq \text{circumference} \leq 36$	mass ≤ 600	$7 \leq \text{height} \leq 10$

Table 1: Measurement of *gasing pangkah* according to player's age

5. Methodology

A survey was conducted amongst 60 students from various courses in one of the public universities. The first section consists of items that are related to students' interest in playing *gasing*. Descriptive statistics is used to analyse data and generate related information.

Qualitative data were gathered from interviews that were carried out at the *Gelanggang Gasing Pangkah* court in Kampung Bukit Kapar, Selangor. The interviews were conducted informally with an expert and very experienced player of *gasing pangkah*. Two meeting sessions with the duration of about 2-hours were conducted and the players demonstrated the game in real time. The interview sessions were recorded and the data from the video were transcribed. The video was played repeatedly for a few times to ensure the vital information and details regarding the mathematics elements are not missed out. The mathematical ideas were identified from the player's knowledge, opinion and perception through words used during the conversation.

6. Results and Discussions

Findings of the study are presented in descriptive statistics and transcription of conversations.

6.1 Students' respond towards *gasing*

The percentage of students interested in playing *gasing* is presented in Figure 4. From the survey, more than half of the students responded that they know how to play *gasing*. However, only 22% are interested in playing it during their leisure time. Majority of them (60%) are slightly interested to play and the remaining of 18% are not interested. Those who are not interested declared that they do not have the basic technique in playing *gasing*.

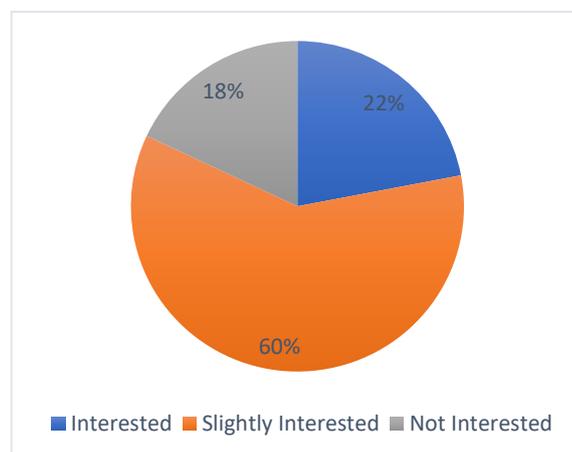


Figure 4: Percentage of students' interest in playing *gasing*

6.2 Expert's background

The Malay player of *gasing pangkah*, Mr. Idrus is a 60 year old man with four daughters. He has about 50 years of experience playing *gasing* and is very passionate in playing this traditional game. He started playing *gasing pangkah* when he was a child and inherited the skills from his late father. He actively teaches several techniques of playing *gasing* to children and adult players in his community and to all his daughters.

6.3 Mathematical Concepts

Some of the mathematical concepts in *gasing pangkah* game were extracted from the interviews with the expert.

6.3.1 Geometry

The geometrical shapes of the *gasing* are identified as three-dimensional solid, whereas the court has several two-dimensional shapes. In general, the shape of the *gasing* is in a cylindrical surface. Mr. Idrus explains the shape of the *gasing* is almost identical throughout all the states in Malaysia. However, there are slight differences in terms of size and shape. For example, the shape of *gasing pangkah* in Selangor is slightly tapered compared to the *gasing* in Pahang. The shape of the body is created a bit thinner and higher than the one in Pahang. The purpose is to get a tighter and firmer grip during the process of tying the string around the *gasing*.

The court is square in shape. There are lines in circular and rectangular shapes. The circle area is the place for throwing the *gasing* at the beginning of the game. The rectangular shape at the four corners known as *petak bela uri*, is an area provided to place the *gasing* before bringing the *gasing* to compete or *uri sah* (the *gasing* still spinning after striking has been attempted).

Example of excerpt from the interview: S = researcher, E = expert

S: *Apa lagi yang boleh kita lakukan untuk susahkan pihak lawan?*

E: *Antaranya yang boleh buat... dari segi pattern gasing tu...*

S: *Macam mana? semua sama ke?*

E: *Tak...lain negeri lain pattern, untuk sekarang ni, kalau Selangor banyak kepada pattern ni, ini pun duplicate daripada design negeri Pahang, untuk Selangor, bahagian body tu, kita nipiskan sikit, sebab tak nak bagi sama dengan Pahang, cuba tengok ni, kan lain...*

S: *Aaaa...nampak, lepas tu dekat bahagian antara kepala dan body nampak Selangor punya design tinggi sikit berbanding yang Pahang.*

E: *Ya...design Pahang ni...kalau main, kena hati-hati sikit lah, sebab genggamannya tak kuat, maknanya ikatan talinya tak berapa kuat.*

6.3.2 Measurement

A special equipment is used to measure the player's *gasing* before the game begins. According to Mr. Idrus, the equipment is in a box shape, which consists of a hole with a circumference of about 14 inches to measure the width or circumference and height of the *gasing* respectively. The *gasing* can be played if it fits into the hole and the height surpasses the height of the box.

Example of excerpt from the interview:

S: *Dari segi ukuran gasing tu macam mana?*

E: *Kalau ada game, kita akan ada satu bekas ukuran, bentuk segi empat, ada lubang, itu untuk lilitan lebih kurang 14 inci...kalau lepas masuk ke dalam lubang tu, maka lulus la...dan dekat bahagian sini, kita akan potong, untuk ketinggian gasing, kalau sangkut, kira lulus.*

S: *Ukur ketinggian gasing ni, macam kita sumbat dalam bekas tu?*

E: *Ya, maksudnya, ketinggian tu, ngam-ngam, bila tak sangkut gasing tu, batal.*

Each striker can only strike one setter's *gasing*. Different length of string is used to tie around the *gasing*. The length of the string for player1 and player2 are shorter than player3 and player4. The first and second strikers adjust the string by using the short length tied around their *gasings* and then release or throw their *gasings* of the setter smoothly. Meanwhile, the third and fourth strikers use the long string tied and ready to attempt and topple by striking the *gasings* of the first two strikers away from the court and drag it to compete *uri sah* to get the game point.

Example of excerpt from the interview:

S: *Pak cik galakkan untuk lagi senang bermain tali pendek ke...tali panjang?*

E: *Tengok dari segi pemukul, maksudnya pemangkah...untuk pemukul1 dan pemukul2 kena tali pendek, maksudnya lilitan ikatan tali pada gasing, dia tak panjang, sebab nak mengalirkan gasing sahaja. Tapi...untuk pemukul3 dan pemukul4, dia perlukan tali panjang untuk keligatan gasing, pasal apa...dia nak cari uri.*

6.3.3 Stability on base area

Kuda-kuda is an idiom in the Malay language. According to Mr. Idrus, it is an act of lowering the body by increasing the base area of the feet to gain stability. It is advisable for the player especially the new players to have a stand-wide of a foot to achieve more stable since wider base area will result in better position to control the body when throwing the *gasing*.

Example of excerpt from the interview:

S: *Yang kuda-kuda tu, apa fungsinya?*

E: *Kalau kita berdiri tegak macam ni, memang susah, kuda-kuda ni sebenarnya untuk kita menahan sambil kita menarik gasing tu.*

S: *Kiranya untuk keseimbangan la.*

E: *Ya...untuk keseimbangan.*

6.3.4 Projectile

Mr. Idrus also showed the demonstration of the basic technique of throwing. It is done with a swinging motion of the hand with the *gasing* inverted before the *gasing* is thrown towards the court or *gasing*'s opponent. According to him, the action of throwing *gasing* indicatively looks like dancing. From his explanation, the mathematical concepts which can be seen through this traditional game are basically related with the projectile concept where it consists of direction, angle and force.

Example of excerpt from the interview:

S: *Dari segi balingan gasing tu macam mana?*

E: *Cara balingan tu...macam kita nak menari, pusingkan ke bawah, campak...tarik, dia ada lenggoknya.*

6.3.5 Weight

Mr. Idrus also stresses on the different impact when striking towards opponent using different materials such as wood and polymer. Translated to mathematical understanding, the force applied through impact is increased when the weight of material is heavier. With more than three decades of involvement in this traditional game, he prefers and is satisfied with playing *gasing* which is made from wooden material. Nowadays, a traditional *gasing* has a weight of between 750 grams to 800 grams. As he grows older, he can hardly play a heavier *gasing*.

Example of excerpt from the interview:

S: *Pak cik pernah main yang jenis plastik atau polimer...ada rasa lain ke?*

E: *Ringan, lagi ringan...jenis plastik ni rasa beratnya tu tak sama...tak puas la, bagi saya memang tak puas...*

S: *Maknanya, bila pangkah gasing tu...dia punya hentakkan gasing rasa lain?*

E: *...Ya, dia punya hentakkan lain, pasal apa...untuk gasing tradisional ni, sekarang kita main tak kurang daripada 750 gram, dia sebenarnya kalau boleh beratnya 800 gram, tapi itulah, kita pun dah tua, tangan pun dah tak kuat.*

6.4 Mathematical Practices

During the interviews, observation is done to identify the mathematical practices from the spoken words of the expert about the practicality which are being applied in playing the game. Among the practices are designing or creating, planning, organizing, executing, visualizing, checking, measuring, adjusting, transforming and estimating.

The strategy used by the team setter is that they must throw their *gasing* closely to one another. He emphasizes that it is very important to give a challenge to the opponent to strike out the *gasing* within a short time which is given in about 10 seconds. Therefore, precision is needed for the team setter to target on throwing the *gasing* as close as possible to each other without touching the other *gasing*, and to use estimation concept in implementing this strategy.

Example of excerpt from the interview:

S: *Itu tektik dia lah?*

E: *Ini memang kena buat kalau nak menang, maknanya...kalau boleh, serapat-rapat yang boleh, sebab apa...untuk pihak pemangkah, dia kena pangkah satu gasing sahaja dan masa lebih kurang 10 saat diberikan untuk memangkah, satu pemangkah satu gasing, bila pukul, dia tak boleh touch gasing yang lain, sebab itulah pemusing ni kena pasang serapat mungkin.*

Table 2 depicts the list of words used by the expert which relate and indicate the mathematical practices in the game.

Words Indicate to Mathematical Practice in the Game	Mathematical Practice
pattern, shape	Designing/Creating
strategy	Planning
group, team	Organizing
throw, strike, arranged players	Executing
placing	Visualizing
pass, fail	Checking
length, height, width, circumference	Measuring
balancing, tying	Adjusting
small, size, duplicate	Transforming
closeness	Estimating /precision

Table 1: Words related to mathematical practices

7. Conclusion

Based on the interview with the expert in *gasing pangkah*, it is obvious that the process of playing *gasing pangkah* carries a lot of mathematical elements, in terms of concepts and practices. From the demonstration of playing the game shown, the information related to mathematical concepts and practices can be observed and analysed. The quantitative data are also substantial for the project to obtain some insights on how much interest the students have toward the *gasing* game and whether they know how to play the actual game.

This traditional game helps to develop social interaction among players since it is an outdoor game and it helps build character through teamwork, struggle, cooperation and many more. This also encourages society to stay physically active as compared to the sedentary nature associated in playing e-games. Apart from that, it can be included as one of the extra-curricular activities in schools where teachers can encourage students to play *gasing* by establishing a club or having a competition in school to cultivate awareness of the Malay heritage and acknowledge it wholeheartedly.

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