Ethnomathematics: exploring the fundamentally mathematical activities and concepts of syawalan in Kaliwungu Kendal

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Abstract. Syawalan in Kaliwungu Kendal is a pilgrimage tradition to Islamic scholar grave who have a major influence in the spread of Islam in the surrounding area. This study aims to explore the fundamental mathematical activities and concept of the tradition. As the initial step of the research, the data about traditions are collected from various sources of literature. This research uses triangulation of sources by interviewing with religious leaders. The data are related to mathematical activities and concepts then. This article describes qualitatively about the results. The finding shows that it contains all of six fundamentally mathematical activities (explaining, designing, measuring, counting, locating dan playing). In the explaining activity, it contains a history of ritual and a shift in meaning to be a carnival. Then, the designing activity can be seen on the iron fence surrounding the tomb of Kyai Guru and various forms of objects in the carnival. Both contain geometry and transformation geometry. The locating activity comes about the determination of direction to graveyard and position of doing ritual syawalan. In mathematics, they can be solved by using optimization methods. Determining the size of blanket for a fence of Kyai Guru’s tomb belongs to the measuring activity. It can be done by using an integration or geometry concept. The counting activity is applied when people do a ritual “dzikr” (remembrance of Allah) by using a set number and playing as the last activity is visible in enjoying the rides and games that can be played in the carnival.

1. Introduction

Ethnomathematics is a study that links mathematics and tradition. It can be used as learning materials when students need to understand a mathematical concept with various representations. Mathematics will feel closer to students by presenting mathematical concepts to the various traditions around them. That is because Indonesia has many traditions from Sabang to Merauke. Some previous researchers have studied ethnomathematics in various traditions and historical items such as ethnomathematics in batik [1] [2], Reyog Ponorogo [3], traditional games [4] [5], Borobudur temple [6], and Gordang musical instrument from the North Sumatra [7].

Syawalan is a series of religious activities carried out by people at Syawal (the 10th month of Islamic Calendar). Different towns have different ritual of Syawalan. For example, Syawalan in Kaliwungu Kendal is in the form of pilgrimage to the Islamic scholar's tomb. That is a contrast to Syawalan as sea alms or Nyadran in Demak. Sea alms is an expression of gratitude to God for the abundance of sea products and prayers of salvation from all dangers [8]. This research specifically discusses Syawalan in Kaliwungu Kendal.

Kaliwungu Kendal is located in Central Java, Indonesia. Syawalan in Kaliwungu Kendal is a pilgrimage tradition to Islamic scholar grave who have a major influence in the spread of Islam in the
surrounding area, such as Kyai Haji Asy'ari a.k.a Kyai Guru. However, this time Syawalan has changed in meaning. Some people know it more as a carnival than a pilgrimage tradition. That is because they mostly enjoy the carnival presented along the way rather than the pilgrimage ritual itself.

Syawalan Kaliwungu has caught the attention of previous researchers. They discussed the background [9], philosophy [10], and development [11]. However, there have been limited studies about ethnomathematics of it. This study aims to discuss the relationship between Syawalan tradition and mathematics. The linkages are analyzed in terms of the fundamental activities and mathematical aspects. Based on Bishop [12], ethnomathematics can be divided into six fundamental activities that can always be found in any existing cultural group; (1) explaining, (2) designing, (3) locating, (4) measuring, (5) counting, and (6) playing. This study describes Syawalan from the six sides of the activities, then each of them is related to the mathematical concepts.

2. Method
This research uses the descriptive qualitative method. It is because this study describes a topic by collecting data in a natural setting in order to obtain an interpretation of a phenomenon [13]. As the initial step of the research, the data about traditions are collected from various sources of literature. This research uses triangulation of sources by interviewing with religious leaders. The data are related to mathematical activities and concepts then. This article describes qualitatively about the results. The technique of data collection of this research is done by triangulation, and the data analysis was inductive. In addition, this study uses an ethnographic approach because it studies social life in a society.

3. Result and discussion
Mathematics can be viewed as a cultural knowledge because it comes from human entrancing in six universal activities consciously and sustainably [12]. They are explaining, designing, locating, measuring, counting and playing that usually called the six fundamental mathematical activities by Bishop. This paper found that Syawalan involves all of the six mathematical activities and described the mathematical aspects contained in each activity at once.

3.1. Explaining
Explaining is “finding ways to account for the existence of phenomena, be they religious, animistic or scientific”[12]. The mathematical activity explaining can be interpreted as an activity to answer the question “why” [14]. There are explaining activities to answer two questions why in Syawalan tradition in Kaliwungu Kendal.

Syawalan appears as a form of Muslim students respect in commemorating the day of their religious leader’s passing away. The commemoration is done by making a pilgrimage to the graveyard and reciting a prayer. As time went by, more and more pilgrims came both from inside and outside of the town. Initially, the main purpose of the pilgrimage was to Kyai Guru’s tomb, but now it reaches other Islamic scholars tomb which lied in graveyard around Kyai Guru such as the grave of Sunan Katong, Kyai Mustofa, Kyai Musyafa and Mbah Ru’yat. It is the first explaining activity to answer why Syawalan arises and develop in Kaliwungu Kendal.

The burial area of Kyai Guru and other Islamic scholars is located on a hill known as Jabal Nur. The pilgrims have to climb a high hill on the way there. At first, the residents hawked foods and drinks to them who passing by the road—however, the more pilgrims, the more traders selling a variety of goods. The traders came both from inside and outside the town. The selling area expanded and centred on the square of Kaliwungu sub-district (it is in front of the al-Muttaqiln mosque) and then became a carnival with many rides. Finally, they mostly enjoy the carnival presented along the way rather than the pilgrimage ritual itself. So that this time some people know Syawalan more as an entertaining carnival than a pilgrimage tradition. It is the second explaining activity to answer why Syawalan has changed in meaning to be an entertaining carnival.
3.2. Locating
Locating as one of the mathematical activities is about locating someone or something in a space [14]. The first locating activity comes about the determination of direction way to the graveyard. Kyai Guru's grave is located at the end of Jabal. It is a high hill located in Protomulyo village. It can be reached from several directions depending on the origin where pilgrims come. Direction way to graveyard can be reached from several paths such as Ngaglik, Jagalan, Pungkurkan, Kembangan and plumbungan. The pilgrims usually choose the path that is closest to the direction they were coming and can be passed easily by their transportation media. Some pilgrims like to go by feet, while others like to ride a motorcycle, car and even a truck in a group of people.

Syawalan is a ritual of reading “dzikr” (remembrance of Allah) in front of the Islamic scholar grave that are done by the pilgrims. They usually find a main place/ position around the tomb to perform the ritual. For ordinary people, they are more likely to choose a position facing the tomb and the direction of the Qibla at once, as shown in figure 1. Meanwhile, the Muslim students in Islamic boarding school tend to go in the opposite direction, which is facing the tomb, but they turn their backs on Qibla direction. This is due to the assumption that the main position is to face each other where the face of the corpse is towards Qibla [10]. Therefore determination of the pilgrims sitting position is included in the second locating activity.

Figure 1. An alternative position in carrying out the ritual of Syawalan

3.3. Counting
Counting is “the use of a systematic way to compare and order discrete phenomena. It may involve tallying, or using objects or string to record, or special number names or words” [12]. When a group of pilgrims arrived at the funeral, they sit around and start the ritual of reading Yasin and Tahlil. Some readings in tahlil are al-Ikhlas 3x, al-Falaq 1x, an-Nas 1x, al-Fatihah 1x back, al-Baqarah 1-5, and thayyibah 33x. Based on that description, they do a counting activity by using a set number concept in the ritual.

3.4. Designing
Designing is “creating a shape or design for an object or for any part of one’s spatial environment. It may involve making the object, as a 'mental template', or symbolising it in some conventionalised way” [12]. The first designing activity appears in the Kyai Guru's tomb fence. The fence made of iron is a combination of two main shapes in geometry. They are a block and triangular prism that can be seen in figure 2.
The second designing activity can be seen in the pattern formed on the side of the Kyai Guru’s fence. The shifting pattern follows the reflection formula in geometric transformations. Reflection is a type of geometric transformation in which all points in a geometrical plane experience displacement towards a line (mirror) as much as twice the point distance to the mirror. The application of this reflection concept to the side of the fence can be visualized in figure 3.

It is inevitable that the carnival has become an important element of Syawalan, so the subsequent study of the designing activity is seen from the carnival side. The third designing activity appears in various forms that exist on rides therein. The rides usually exist carousel, ferris wheel and ball bath rides. All of those rides apply geometry concept. The roof of carousel is a conical surface. The Ferris wheel is like a circular wheel. Meanwhile, the ball bath clearly contains a ball element in it. The rides and their implementation in geometry concept are shown in figures 4-6.
Figure 4. The roof of carousel ride is a conical surface.

Figure 5. The ferris wheel is a circle

Figure 6. The ball bath is application of the spherical shape or ball element
3.5. Measuring
Measuring is “quantifying qualities for the purpose of comparison and ordering, using objects or tokens as measuring devices with associated units or measure-words” [12]. The implementation of measuring activity at Syawalan appears in determining the size of the fence cover of Kyai Guru’s tomb. That is because people have to take the measurement of how many $m^2$ or $cm^2$ the wide of cloth cover is needed, as shown in figure 7. This is one of the geometry concept application. This case can be done by measuring the surface area of a block and triangular prism without the bases of each.

![Figure 7. The cloth cover of Kyai Guru’s tomb](image)

3.6. Playing
Playing is “devising, and engaging in, games and pastimes, with more or less formalized rules that all players abide by” [12]. Ferris wheel as one of the rides in Syawalan carnival moves in a circle shape several times. It takes passengers by applying existing safety requirements. The passengers board and obey the rules. It also applies to other rides and games in a carnival. People follow the rules, and they brings a sense of satisfaction and pleasure to the pilgrims who enjoy the rides, especially for children. The playing activities exist in those delightful rides in Syawalan carnival.

4. Conclusion
This research shows that Syawalan contains all six of fundamentally mathematical activities: explaining, designing, locating, measuring, counting and playing. (1) In the explaining activity, it contains the history of ritual and a shift in meaning to be a carnival. (2) The designing activity can be seen on the iron fence surrounding the tomb of Kyai Guru and various forms of objects in the carnival. Both contain geometry and transformation geometry. (3) The locating activity comes about the determination of direction to graveyard and position of doing ritual syawalan. In mathematics, they can be solved by using optimization methods. (4) Determining the size of blanket for a fence of Kyai Guru’s tomb belongs to the measuring activity. It can be done by using an integration or geometry concept. (5) The counting activity is applied when people do a ritual “dzikr” (remembrance of Allah) by using a set number. (6) While playing as the last activity is visible in enjoying the rides and games that can be played in Syawalan carnival.

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