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“Optimizing Innovation in Knowledge, Education and Design”

EXTENDED ABSTRACT



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Assalamualaikum warahmatullahi wabarakatuh,



First and foremost, I would like to express my gratitude to the organizing committee of i-Spike 2023 for their tremendous efforts in bringing this online competition a reality. I must extend my congratulations to the committee for successfully delivering on their promise to make i-Spike 2023 a meaningful event for academics worldwide.

The theme for this event, 'Optimizing Innovation in Knowledge, Education, and Design,' is both timely and highly relevant in today's world, especially at the tertiary level. Innovation plays a central role in our daily lives, offering new solutions for products, processes, and services. By adopting a strategic approach to 'Optimizing Innovation in Knowledge, Education, and Design,' we have the potential to enhance support for learners and educators, while also expanding opportunities for learner engagement, interactivity, and access to education.

I am awed by the magnitude and multitude of participants in this competition. I am also confident that all the innovations presented have provided valuable insights into the significance of innovative and advanced teaching materials in promoting sustainable development for the betterment of teaching and learning. Hopefully, this will mark the beginning of a long series of i-Spike events in the future.

It is also my hope that you find i-Spike 2023 to be an excellent platform for learning, sharing, and collaboration. Once again, I want to thank all the committee members of i-Spike 2023 for their hard work in making this event a reality. I would also like to extend my congratulations to all the winners, and I hope that each of you will successfully achieve your intended goals through your participation in this competition.

Professor Dr. Roshima Haji Said
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UiTM KEDAH BRANCH



WELCOME MESSAGE (i-SPIKE 2023 CHAIR)



We are looking forward to welcoming you to the 3rd International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2023 (i-SPIKE 2023). Your presence here is a clear, crystal-clear testimony to the importance you place on the research and innovation arena. The theme of this year's Innovation is "*Optimizing Innovation in Knowledge, Education, & Design*". We believe that the presentations by the distinguished innovators will contribute immensely to a deeper understanding of the current issues in relation to the theme.

i-SPIKE 2023 offers a platform for nurturing the next generation of innovators and fostering cutting-edge innovations at the crossroads of collaboration, creativity, and enthusiasm. We enthusiastically welcome junior and young inventors from schools and universities, as well as local and foreign academicians and industry professionals, to showcase their innovative products and engage in knowledge sharing. All submissions have been rigorously evaluated by expert juries comprising professionals from both industry and academia.

On behalf of the conference organisers, I would like to extend our sincere thanks for your participation, and we hope you enjoy the event. A special note of appreciation goes out to all the committee members of i-SPIKE 2023; your dedication and hard work are greatly appreciated.

Dr. Junaida Ismail

Chair

3rd International Exhibition & Symposium Productivity, Innovation, Knowledge, and Education 2023 (i-SPIKE 2023)

KOMPANG ILLUSTRATION BY USING EQUATION OF CURVE

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ABSTRACT

Mathematics, culture, and arts are mutually influential where the relation of mathematics in culture and arts already exists from the past. The expansion of knowledge on ethnomathematics leads to the relationship between mathematics and culture. In Malaysia, there are many cultures, which the main are Malay culture, Indian culture, Chinese culture, etc. However, this study will focus on Malay culture and its musical instrument, the kompang. Kompang is the Malay community's common traditional musical instrument. Culture involves the shared understandings through which individuals interact with each other, but to see it from a mathematical perspective, some study needs to be carried out, like how the equations can illustrate the image of kompang. To see the physical features of kompang through mathematics, the equation of kompang will be produced by using the equation of a circle and the equation of a quadratic bezier curve. The formulation of the equation for kompang is made using Maple software. Through observation and measurement of actual kompang, the information is used to form the image of kompang and the equation of kompang. From the result, we can see how mathematics can relate to culture and vice versa, and it gives another idea in the classroom to see the application of mathematics from another perspective. Whatever is around us has its own mathematical point of view, and through this study, we believe the flexibility of the equation can form a variety of shapes like kompang.

Keywords: Kompang, Bezier Equation, Circle Equation

INTRODUCTION

Kompang is the Malay community's common traditional musical instrument. It is the part of the instruments in the drum section. Although the origin of kompang in Malaysia is still disputed, major researchers believe that its origin was from the Middle East and was brought

to Malaysia through state of Johor and Melaka by traders in the thirteenth (Senan et al., 2009). The kompang is a single-headed frame drum made up of two main parts, the *baluh* (frame) and the *muka* (head). The *baluh* is a frame constructed from a circular shape of tropical hardwood. The *muka* is the drumhead made of animal hide skin (called *belulang* or *kulit*), goatskin hide, or cowhide, depending on the type of kompang.

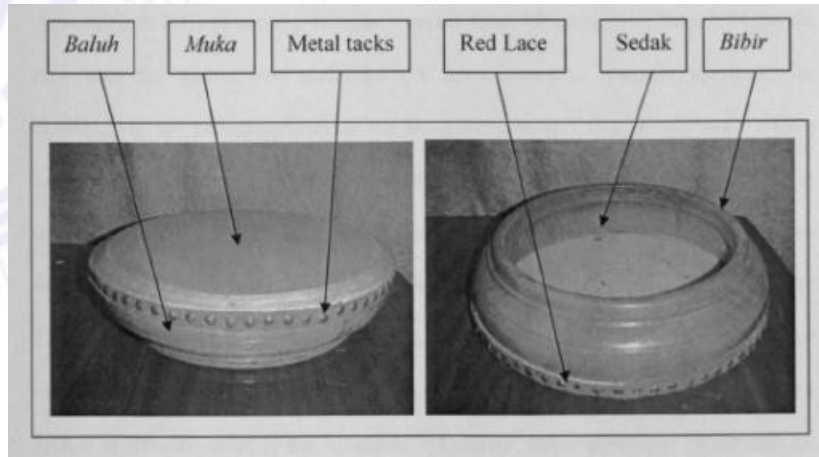


Figure 1. The structure of kompang (Abdullah, 2005)

From previous study, a mathematical model of the kompang membrane is developed to simulate the vibration of the kompang membrane in polar coordinates by implementing the Fourier-Bessel wave function (Siswanto et al., 2018). Based on the same object(kompang), and from a mathematical point of view, mathematical study is tried to be applied to illustrate the image of the kompang through the equation of a circle and a quadratic bezier curve.

The expansion of knowledge on ethnomathematics leads to the relationship between mathematic and cultural. There is a lot of culture in this world that produces its own product as a symbol for their culture by using different types of shapes. As an example, one of Malay culture's music instrument, kompang, used two different sizes of circles and a curve shape on the *baluh* of the kompang. Kompang used two different sizes of circles, which were applied on top of the kompang and the bottom of the kompang. A circle is a type of line that is formed from a closed-plane curve where all points on the line are the same distance from the centre. A circle is a 2-dimensional (2D) shape where it can be transformed into the Cartesian plane of the x-axis and y-axis. It is important to know the difference between the shape of a circle and a sphere since both shapes are not on the same dimension. Since the size of the two circles on kompang is not equal to each other, therefore the radius of each circle is not the same either. To get the equation of kompang, the equation of circle is very necessary to know specially to create the equation for part of *muka* and *bibir*. The general equation of circle: $(x - h)^2 + (y - k)^2 = r^2$ where, (x, y) is any point on the circle, (h, k) is a center point of the circle and r is the radius of the circle.

To complete the illustration of kompang by using the equation, the curve of the quadratic Bezier equation is applied. This equation is applied to create the frame(*baluh*) part. Hassan et al. (2015) stated in their study that quadratic Bezier curve can be formulated by blending two quadratic Bezier curves. Curve shapes are also part of geometrical study, which can be written in the form of a formula in many different degrees depending on the shape of the curve itself. To find the equation of the curve on the baluh of the kompang, the equation of Bezier curves is chosen. According to (Harwood et al., 2009), the advantage of using Bezier curves is their flexibility and high adaptability since every point on the curve can be attached to a Cartesian coordinate system. Mathematically, the curve is determined by a pair of parametric equations with $0 \leq t \leq 1$ and a single control point and two terminal points that will produce a quadratic equation.

In this project, a quadratic Bezier curve is the best to represent the curve on the side of the kompang, for which there will be only one control point and two terminal points. The equations of the quadratic Bezier curve are for $b(t) = (1-t)^2 b_0 + 2t(1-t)b_1 + t^2 b_2$ for $t \in [0,1]$.

METHODOLOGY

The equations of kompang are analyzed based on the characteristics of kompang. The kompang has two shape of circles which are located on the top and the bottom of the kompang, known as *muka* and *bibir*. For the sides of kompang(frame), it will be illustrated using quadratic Bezier curves. To illustrate the image of kompang by using the equation, actual data is used where the real measurement need to record.

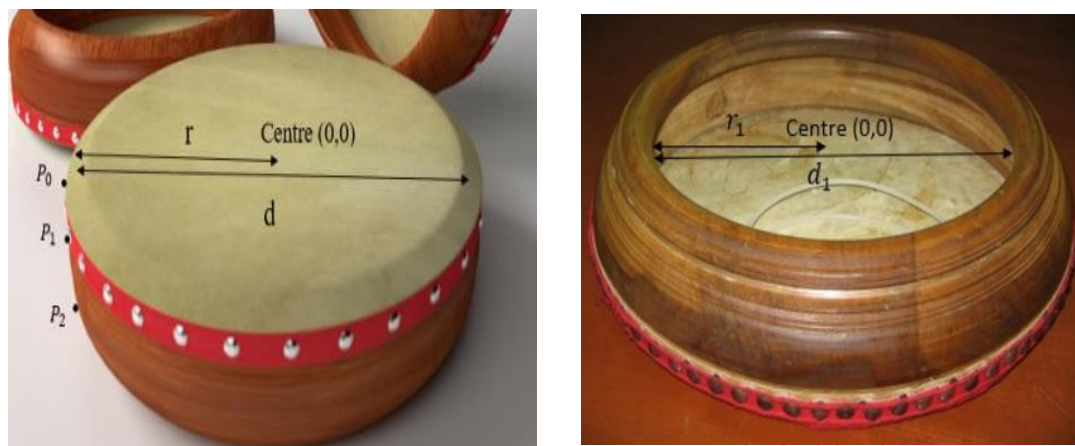


Figure 2. The structure of top(*muka*) and bottom(*bibir*) kompang.

The measurement for the dimensions of kompang that recorded based on figure 2 are:

- i. r_1 : radius of circle on top of the kompang
- ii. d_1 : diameter of circle on top of the kompang
- iii. P_0 : initial point of kompang
- iv. P_1 : control point of kompang
- v. P_2 : end point of kompang
- vi. r_2 : radius of circle of bottom of the kompang
- vii. d_2 : diameter of circle of bottom of the kompang

All the measurements collected are used to formulate the equation of *kompang* using the general formula of the circle equation and quadratic Bezier curves. In this stage, control points are applied to form the equation for the side of the *kompang* by using the general equation of the quadratic Bezier curve. While radius and diameter are used to form the equations of *muka* and *bibir* by using the circle equation.

RESULTS AND DISCUSSION

To illustrate the image of *kompang* through the equations, data are collected as shown in Table 1. *Kompang* used is 10 inch in size and note that, from the measurement of *kompang*, point P_0 , P_1 , and P_2 is computed.

Table 1. Measurement of *kompang* dimensions

Dimension	Quantity of Dimension (inch)
r_1	15
d_1	30
P_0	(15,0)
P_1	(14,3)
P_2	(11, -5)
r_2	11
d_2	22

Figure 3, 4 and 5 displays an example of *kompang* created using data from Table 1 and Maple software by using a general equation for a circle and a quadratic Bezier curve.

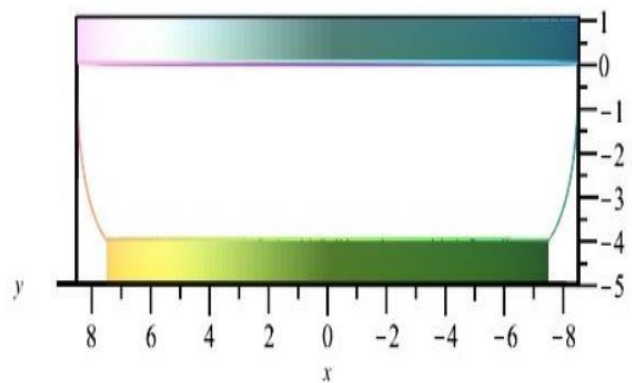


Figure 3. The side view of the kompang

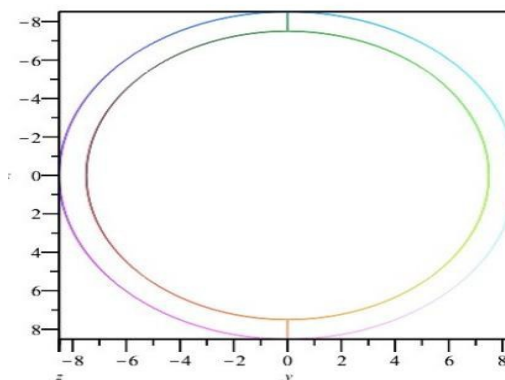


Figure 4. The top view of the kompang

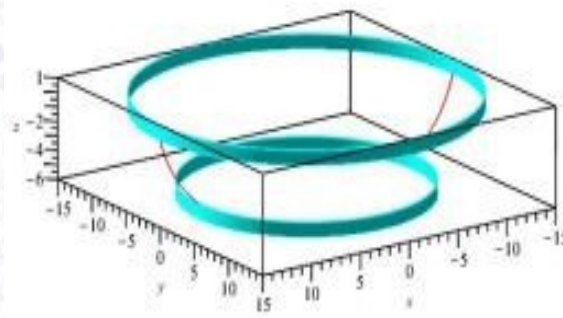


Figure 5. Model of kompang

From the figure, as a round shape being transferred into mathematical formula, it becomes the equation of circle while the equation of Bezier curve is for the rigid shell that is *baluh*.

CONCLUSION

As is well known, curves have numerous applications in numerous fields of study, including mathematics. They are used to understand the properties of functions, model real-world phenomena, and solve complex mathematical problems. As we can see in this study, curves such as the circle and Bezier have specific equations and play a fundamental role in algebraic geometry, such as in the formation of diagrams, in this case the diagram of kompang. The versatility and beauty of curves make them an indispensable tool in many fields of study.

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