# Exploration of Mathematical Concepts in Traditional Used Tire Racing Games

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| ARTICLE INFO | ABSTRACT |
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| **Keywords:**<br>Ethnomathematics;<br>Traditional Games,<br>Mathematics learning | Traditional games are played in a simple way. Some types of games require tools, while others do not. Cultural values are contained in these traditional games, which originated from our ancestors. It is expected that the incorporation of the traditional game of scrap tire racing with mathematics learning will increase participants' interest in traditional games and mathematics. An approach known as "ethnomathematics" involves incorporating mathematical concepts into local culture. Mathematics is often perceived as a difficult subject by students, resulting in students' low interest in math materials. As this research focuses on a cultural phenomenon in Indonesia relating to the traditional old tire racing game, using a qualitative descriptive method and ethnographic approach. To help preserve the traditional game, this research aims to reveal the mathematical aspects contained in the traditional game. The results showed that mathematical concepts related to flat shapes, spatial shapes, track length, speed, distance, and time were used in the old tire racing game. The 56 cm diameter scrap tire reaches the finish line first because it has a larger circumference of 176 cm and the distance traveled each lap is longer than the 48 cm and 38 cm diameter scrap tires. |
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## INTRODUCTION

Traditional games in Indonesia used to be in great demand before the emergence of modern technology. In those days, children often played with what was available without the need to use sophisticated equipment. However, nowadays, children tend to play with technology-based games that come from abroad. With the rapid development of the times, traditional games are slowly starting to shift from the attention of children in Indonesia. In fact, many of them have never known the traditional game at all.(Putra Arima, Tarsyad Nugraha, 2018) Traditional games are a simple form of game, with some types requiring equipment and some that do not require equipment. This game is rich in cultural values inherited by the ancestors.(Lonny Vion D, 2023) The types of traditional games are very diverse and are influenced by a variety of different factors such as geographical, economic, social, and local culture. Because of this, each region has its own unique traditional games, which are influenced by the customs, customs, and myths of the region, which have an impact on the way the local people play traditional games.(Ari Wibowo Kurniawan, 2019)

Traditional games can also develop the social aspects of children and increase their awareness of the surrounding environment. In addition, there is an element of learning mathematics in traditional games. Mathematics subjects are often considered difficult because they involve formulas that must be memorized, and understanding the concepts of mathematics taught by teachers is sometimes difficult for students to digest.(Faris Nur Khulafa, 2018) According to (Novita Maulidya Jalal, 2022) mathematics is often considered a difficult subject by students, so their interest in this subject is still limited. In addition, these unpleasant experiences are sometimes transmitted to others, causing people who are going to study mathematics to also consider mathematics to be a difficult field of study. This indirectly affects students' interest in mathematics.(Prayuga & Abadi, 2019) Mathematics learning can be more interesting for students if it is delivered in a specific and easy-to-understand way according to their level of knowledge. One effective approach is to incorporate elements of mathematics into the context of local cultures, known as ethnomathematics.(Jhenny Windya Pratiwi, 2020) Ethnomathematics is a branch in the field of mathematics education that relates the concept of mathematics to the culture in the environment where students live. This can be done through various aspects, such as traditional games that are part of daily life.(Indah Wahyuni, 2021)

Ethnomathematics approaches can increase students' active involvement in the learning process, encouraging students to actively participate in learning activities. Therefore, ethnomathematics is considered very relevant in the context of mathematics learning, especially in Indonesia which has an abundant wealth of art and culture. (Ajmain, Herna, 2020) However, ethnomathematics is a part of mathematics that serves as a link between formal concepts and its practice in culture, it is not an idea that will abolish formal systems from mathematics. Instead, it serves as a tool to further humanize mathematics.(Andi Saparuddin, Y L Sukestiyarno, 2019) One of the famous traditional games in Indonesia is the Used Tire Racing. Playing used tire racing can contribute to the development of gross motor skills, particularly when it comes to locomotor movements in early childhood. Used tire racing games are able to stimulate gross motor aspects by developing agility and stability of the child's body.(Ifadatul Muafikoh, 2018) In the field, students' expressions show how effective and efficient this perceptual motor game is. Students look very excited and happy while playing the game and they play well.(Asriansyah, 2020)

The researchers sought to integrate the traditional game of used tire racing with mathematics learning, with the aim of increasing interest in mathematics and the traditional game. The researcher also hopes that through this used tire racing game, children will be able to understand the concepts of flat building, building space, track length, speed, distance and time contained in the game. The hope is that we, as the nation's young generation, can properly and correctly maintain our cultural heritage even though the times continue to develop and technology is increasingly sophisticated. Based on this explanation, the research will be focused on the field of ethnomatics with the title "Exploration of Mathematical Concepts in Traditional Games of Used Tire Racing**.**

**METHODE**

This study uses a qualitative descriptive method with an ethnographic approach because it is rooted in Indonesian cultural phenomena related to the traditional game of used tire racing. Qualitative research methods aim to describe and explain in-depth phenomena through detailed data collection.(Manan, 2021) Data collection was carried out by observation and literature study. Observations were made on children who were playing used tire racing

games. The traditional game chosen for this study is the traditional game of used tire racing, which can be enjoyed by both men and women. The researchers also aim to better understand the relationship between mathematics and the traditional game of used tire racing. Qualitative data analysis will involve the use of words to detail and explain the findings of this study.

## RESULT AND DISCUSSION

One example of a traditional game that combines elements of math learning is the used tire racing game. This game is a creation using used tires and a beating tool made of wood or bamboo blades. The size of used tires and wood/bamboo blades used by children varies greatly according to what they find in their respective areas. The way he plays is rolling a scrap tire and then hitting it with a stick or bamboo blade to keep the tire spinning. Next, the children will run together along the trajectory of the tires along with other children.(Adelianti Derman, 2022)



**Gambar 1. Alat Permainan Tradisional Balapan Ban Bekas**

Describes the used tire racing game as a form of traditional racing game where participants use a stick to push a tire to reach the *finish* line without falling. The game involves used tires that are no longer used, as well as a beating device measuring about 15 cm.(Ifadatul Muafikoh, 2018) Meanwhile, according to (Putra Arima, Tarsyad Nugraha, 2018), the Beater is usually made of wood with a length of about 40 cm. The severity of the blow to the tire can affect the speed of the tire itself, therefore, participants need to adjust their feeling so that the tire speed matches their speed when running along the tire. It's important not to make the tyres so fast that it's hard to catch up, and the basic rules are similar to races in general, starting from the *start* line and sprinting towards the *finish line*.

Based on the results of observations and documentation on the traditional game of used tire racing, it has been used to find mathematical aspects that can be linked to a field of mathematical study referred to as ethnomathematics. Furthermore, a literature analysis has been conducted to explore the mathematical concepts associated with the game, and a more detailed explanation can be found below.

## Circles on Used Tires

Waste tires are a type of waste that is generally generated from motor vehicles, which have a circular shape with different diameters depending on the type of vehicle and tire

condition. Children in various places often find used tires on the side of the road, in landfills, or even in their own yards. Tires with diameters of 56 cm, 48 cm, and 38 cm are some examples of used tires that can be found. The diameter varies depending on the vehicle and its size. One of the sizes of the used tires can be seen in the picture below:
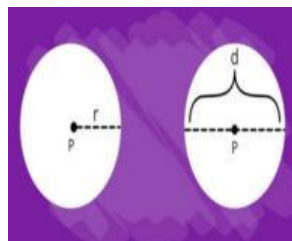


**Figure 2. Used Tires**          **Figure 3. Circles**

The learning that students get from used tires includes understanding mathematical concepts such as diameter, radius, and circle. By measuring used tires, students can apply the concept to real-world situations and understand how to calculate circumference and circumference area. This learning process allows students to directly measure the used tire to find out its diameter and radius. The diameter is a straight line that cuts the center of the circle and divides it into two equally large parts. The radius, on the other hand, is the distance from the center of the circle to the edge of the circle. Knowing the diameter and radius of an scrap tire allows students to practice mathematical concepts by calculating the circumference and area of the circle. A formula for calculating the circumference and area of the circle.

**Rumus keliling lingkaran**          **Rumus luas lingkaran**

$$K = 2\pi r \text{ atau } K = \pi d$$          $$L = \pi r^2 \text{ atau } L = \frac{1}{4}\pi d^2$$

**Information:**
K = Circumference of the circle
L = Circle area
π = Phi (valued at 22/7 or 3.14)
r = Radius of a circle
d = Circle diameter

The circumference formula gives an idea of the length of the curve of a circle measured along its edges. In addition, to calculate the area covered within the circle, students can use the circle area formula. Thus, students can calculate the circumference and area of the circle by entering the values of the radius measured on the scrap tire into the formula. The application of formulas when learning with used tires gives students a realistic and relevant experience. Not only will you learn theoretical mathematical concepts, but you will also see how these concepts can be applied in everyday situations. In addition, this research can also encourage students' interest in mathematics by providing an interesting and different context. Therefore, learning through measuring and calculating used tires can improve students' understanding of

mathematical concepts and improve critical thinking, problem-solving, and concept application skills. They learn how to connect mathematical theory with practical applications in everyday life. In addition, learning with used tires allows students to develop data measurement, observation, and analysis skills. These are all essential skills in learning math and everyday life. Therefore, using used tires as a learning tool can provide students with a fun and meaningful learning experience while deepening their understanding of basic mathematical concepts.

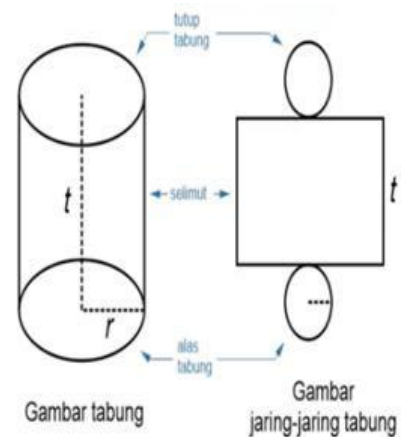**Hitting Tools on Used Tire Racing Games**



**Figure 4. Used Tire Racing Game Stick**          **Figure 5. Tube**

The batting sticks used in used tire racing games play an important role in connecting fundamental mathematical concepts with real experience. A tubular bat not only serves as a tool for hitting and pushing used tires, but also becomes a fun learning object that helps students understand the concept of building spaces, especially tubes. Students introduce themselves to the concept of building spaces, especially tubes, by looking directly at the bat. A tube is a building space consisting of two parallel circles connected by a curved surface. The shape of this tube can be clearly seen on the batting stick used in the used tire racing game, which has a circular end and a cylindrical surface in between.

Once students understand the basic concepts of the shape of the tube, they are then asked to calculate the volume and surface area of the tube. The volume of the tube is the size of the space filled by the tube, and the surface area of the tube is the total surface area of the tube. To perform this calculation, students must know the height of the tube and the diameter or radius of its top circle, using the following formula:

| Tube volume formula | Tube area formula |
|---|---|
| $V = \pi \times r^2 \times t$ | $L = 2\,\pi\,r\,(r + t)$ |

Using these formulas, students can apply their knowledge of the diameter, radius, and height of the tube they observe with a batting stick to calculate their volume and surface area. During this process, students gain an understanding of how mathematical concepts can be applied to real-world situations that are interesting and relevant to them. They not only study concepts and formulas theoretically, but also look at how they can be applied in a variety of situations. When students use batons in used tire racing games, they also learn social skills and motor skills. They also learn how to work together and interact with their peers in the game while improving their fine motor skills. It combines math learning with real physical activities, which makes learning more expansive and enjoyable for students.

The use of batons in used tire racing games can also increase students' interest in math because it provides them with an engaging and meaningful context to play. They can see how mathematical concepts can be applied in everyday life situations, which can increase students' desire to learn and help them understand mathematical concepts better. The use of batons in used tire racing games not only helps students understand the concept of building space, but also helps them learn math through physical activities and everyday experiences. This makes learning fun, meaningful, and well-rounded for students and enhances their interest in math and learning as a whole.

The use of tubular bamboo sticks without lids is an exciting opportunity for students in mathematics learning to explore geometry concepts further. This capped tube shape offers students the opportunity to deepen their understanding of mathematical formulas relating to the surface area of a building. After understanding the concepts of the tube volume and surface area formula, students can continue their learning by learning the formula of tube surface area without lid. A tube without a lid is a form of tube that does not have a cap on one side. In the case of bamboo sticks used in used tire racing games, one end may or may not be closed, so that it resembles a tube without a lid. Then students can calculate the surface area of the tube without a cap using the formula below.

**Formula of tubeless tube area**

$$L = \pi\ r\ (r + 2t)$$

Description: V = Tube volume
L = Tube surface area
$\pi$ = Phi (22/7 or 3.14)
r = Radius of a circle
t = Tube height

The main difference from the formula for calculating the surface area of a regular tube is that in this formula one side of the circle is missing, so the area of the tube cap is not increased. Therefore, using this formula, students can calculate the surface area of the tube without a lid by entering the values of the radius and height of the tube obtained by directly observing the bamboo blade. In addition, by using a tubular piece of bamboo without a lid, you can gain a deeper understanding of the properties of the shape of the space and the geometric properties. They can see the difference in the shape of a tube without a cap with a regular tube and its effect on the calculation of surface area. This research can also stimulate students' interest in mathematics by providing an interesting and meaningful context.

**Lots of Tire Spins on Used Tire Racing Games**



**Figure 6. Used tire race participants**

Used tire racing games offer more than just fun and excitement. The concept of "many laps" in this race refers to the number of laps a participant must complete around the track of a used tire before reaching the finish line. The number of laps is not only a benchmark of success in a race, but it also opens up opportunities to apply some important mathematical concepts. One of the mathematical concepts that can be applied in this game is the calculation of the length of the tire trajectory. Participants and observers can use their knowledge of geometry and measurements to determine the length of the race track. This involves measuring the length of each side of the track, calculating the distance between the starting point and the finish line, and evaluating the track surface conditions that may affect the speed of the participants. The mathematical formulas used in this context include:

**Tire Track Formula**

**Tire Lot Rotation Formula**

**Traverse = Circumference x Many Laps**

**= Circumference : Circumference**

In addition, in used tire racing games, the concepts of distance, speed, and time become very important. Participants can calculate the total distance traveled during the race by knowing the length of the track and the number of laps required. Then, they can divide the total distance by the time it takes to complete the race to find out their average speed. This allows participants to evaluate and improve their race strategies to achieve higher speeds each lap. With distance s, average speed v, and travel time t, the relationship between distance, velocity, and time is as follows:

Distance(s) = v x t

$Speed$ (v) = $\frac{s}{t}$

$Time$ (t) = $\frac{s}{v}$

The application of these formulas allows participants to conduct a more in-depth analysis of their performance in the competition. They can use the data they collect during the race to find areas where they can improve their overall speed, efficiency, or race strategy. Using

used tires, players can use hands-on math to learn how geometry affects their performance in races by comparing the sizes and circumference of different used tires.

First, let's look at three used tires of different diameters. The 56 cm diameter tire has a circumference of 176 cm, the 48 cm diameter tire has a circumference of 150.72 cm, and the 38 cm diameter tire has a circumference of 119.32 cm. From this information, it can be seen that used tires with larger diameters have a longer circumference, which means they can travel longer distances to use. When used tires are used in racing games, used tires with a larger circumference will reach the finish line faster. In this case, a used tire with a diameter of 56 cm has a circumference of 176 cm, which is larger than the other two used tires, so a used tire with a diameter of 56 cm will reach the finish line first. Participants in the used tire racing game can create a better strategy to improve their performance by knowing how the diameter, circumference, and distance traveled each lap are correlated. They can plan steps that can help them reach the finish line faster by considering things like tire size, speed, and efficiency. As a result, the game is not only used for fun.

## CONCLUSION

The conclusion that researchers can draw is that many people are no longer interested in traditional games, one of which is the used tire racing game. Many people are not aware of the value of mathematics learning in traditional games. It turns out that in the used tire racing game it contains materials for flat builds, building space, track length, speed, distance, and time. Used tires with a diameter of 56 cm will reach the finish line first, because they have a larger circumference than the other two used tires, which is 176 cm. As well as the distance traveled each round of the used tire which is 56 cm in diameter is greater than the used tire which is 48 cm and 38 cm in diameter. At least this research can show that the value of mathematics is not only in school lessons, but mathematics learning is also contained in daily life. With this research, the researcher became more aware of mathematics learning contained in mathematics learning. Teachers can integrate more math concepts into other traditional games. This can help students understand math concepts in a more fun and practical way. Incorporating local culture and mathematics in education can have a sustained positive impact on increasing students' interest in mathematics while preserving traditional cultural heritage.

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