

COMPARING THE SOUNDS PRODUCED ON TIN PHONES WITH DIFFERENT MEDIUMS

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Abstract (English)

The tin can telephone is considered a simple traditional game but can also be used as a learning tool. This device operates on the principle of waves, utilizing the propagation of sound in a medium. The tin can telephone makes use of recycled materials available in the surrounding environment, specifically repurposed cans, to demonstrate the principles of mechanical waves transmitting sound through a solid substance. The aim of the conducted research is to analyze the differences in the sound produced by the tin can telephone, examine the influence of the length and type of string, and identify the factors contributing to the variation in sound produced by each medium. The research adopts a qualitative method, involving data collection and analysis using standardized and objective tools. The recycled cans used in this study serve as a set of aids for learning about sound waves produced by strings and cans. Three different propagation media were employed: kite string, woven nylon thread, and copper wire. The sound produced by these three media differs; the string medium produces clear and loud sounds, even with varying lengths, whereas the copper wire results in less clear and quieter sounds. The length of the string affects the produced sound – longer strings result in louder sounds, while the opposite is observed with wire, where longer lengths lead to unclear sounds. The variation in sound across media is attributed to the different source materials for sound and the distinct particle counts in each substance.

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Key Words

tin, wave, sound

Abstrak (Indonesia)

Telepon kaleng termasuk permainan tradisional sederhana, tetapi dapat digunakan juga untuk media pembelajaran. Telepon kaleng ini menggunakan prinsip dari gelombang yaitu memanfaatkan prinsip perambatan bunyi dalam medium. Telepon kaleng memanfaatkan bahan-bahan bekas yang ada di lingkungan sekitar. Kaleng bekas yang dapat digunakan bertujuan untuk membuktikan tentang gelombang mekanik yang dapat merambatkan bunyi melalui zat padat. Tujuan dari penelitian yang dilakukan adalah untuk menganalisis perbedaan bunyi yang keluar pada telepon kaleng, menganalisis pengaruh panjang tali dan jenis tali dan mengetahui faktor-faktor yang mempengaruhi mengapa bunyi yang dihasilkan dari setiap medium berbeda. Penelitian ini menggunakan metode kualitatif, yaitu penelitian dengan mengumpulkan data dan menganalisis data dengan menggunakan alat yang objektif dan baku. Kaleng bekas yang dipakai dalam penelitian ini adalah seperangkat alat bantu pembelajaran gelombang bunyi yang dihasilkan dari tali dan kaleng. Medium perambat yang digunakan ada 3 yaitu kenur layangan, benang nilon rajut dan kawat tembaga. Bunyi yang dihasilkan dari 3 medium tersebut berbeda, pada medium tali menghasilkan suara yang jelas dan nyaring sekalipun panjang mediumnya berbeda sedangkan pada kawat tembaga bunyi yang dihasilkan kurang jelas dan pelan. Panjang tali mempengaruhi bunyi yang dihasilkan, apabila tali yang digunakan bertambah panjang maka bunyi akan semakin besar sedangkan kawat berbanding terbalik, apabila semakin panjang

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Kata Kunci

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kawat maka suara yang dihasilkan akan tidak jelas. Bunyi yang dihasilkan dari setiap medium berbeda, karena disebabkan oleh jenis bahan sumber bunyi tersebut. Selain itu, karena jumlah partikel pada setiap benda juga berbeda.

Introduction

The tin phone is a simple traditional game that is fun and can be used for educational purposes. The tin phone is interpreted with two words: phone and cans. The Indonesian Big Dictionary has described a telephone as a communication device with electricity and cables to talk between two people who are at a distance (Asmaroini, 2018). The tin can telephone can be used to illustrate the basic concept of sound waves and the interaction of sound structures. It can also be used to illustrate advanced concepts related to frequency response and speech clarity in acoustic communication. In this research, we observed voice transmission and found that some sounds were transmitted more clearly than others. The measured frequency response functions for several tin can telephones were constructed using different types of strings (Jason D. Sagers, 2011).

Waves are one of the natural phenomena that occur in everyday life. Waves are among the topics studied in physics. Vibrations are the source of waves (Giancoli, 2001). The tin phone is a simple traditional game that is fun and can be used for educational purposes. Sound is produced by the vibration of an object that travels through a medium at a certain speed. Vibrations create a series of compressions and rarefactions that propagate through the air. Waves are the transmission of vibrational energy that travels through a medium or even without a medium (Halliday, 2010). Based on their medium, waves are classified into two types: mechanical waves and electromagnetic waves. Mechanical waves are those whose propagation requires an intervening medium, while electromagnetic waves are those that propagate without the need for a medium (Widyastika, 2020). Wave motion can be seen as the transfer of energy and momentum from one point in space to another without the transfer of matter (Tipler, 1998)

Wave propagation through a medium can be categorized into two types: mechanical waves and electromagnetic waves (Nurza, 2020). Mechanical waves are waves that require a medium to propagate. Sound generated by vibrations in an object that can travel through a medium at a certain speed will cause compression and rarefaction that propagate through the air. When propagating through a medium (such as a rope, water, or gas), the wave will carry energy from its source (Surya P. Y., 2009). Meanwhile, longitudinal waves are waves whose propagation is parallel to the vibrations and the medium (Bambang, 2009)

The mass density of the rope and the tension in the rope are related and affect the speed of wave propagation. When the tension in the rope increases, the speed of wave propagation also increases. On the other hand, when the mass density of the rope increases, its inertia becomes larger, leading to a decrease in the speed of wave propagation (Ahmad Khotibul Umam*, 2020). Waves can also be defined as vibrations (oscillations) that propagate through a medium or even without a medium, without involving the actual displacement of the medium's particles (Jumini, 2015).

The goal of the conducted research is to analyze the differences in sound emitted from tin can phones, examine the influence of string length and type, and identify factors affecting why the sound produced varies in each medium. In our study, we utilized three types of sound propagation mediums in the telephone experiment specifically nylon string, kite string, and wire.

From the reference journals we encountered, the results obtained are consistent with those conducted and align with existing theories. There is a noticeable similarity between our findings and those of previous research, namely the use of the same materials. To differentiate, the only variation lies in the length of the string used, but there is one distinct difference, which is the use of wire. And the results obtained are in line with the theory of string density

Method

In this experiment, we created three pairs of toy telephones with different string lengths. For the first telephone, we used knitted nylon thread, kite string, and copper wire with a diameter of 0.04 mm.

The tools and materials needed for making tin can telephones include cigarette cans, knitted nylon thread, kite string, scissors, and a tape measure. After preparing the tools and materials, we proceed to the tool-making process, 1) Prepare two small-sized milk cans, 2) Make a large hole on one side of the can for sound reception, 3) Make a small hole on the other side of the can to insert the sound propagation medium, 4) Insert the medium to be used on the side with the small hole, and 5) Repeat the process, replacing the sound propagation mediums.



Picture 1. Tin Phone

During the experiment, we positioned ourselves in a quiet place to ensure that the sound heard clearly originated from the string propagation into the can. Conducting the experiment in a reverberant room would produce echoes throughout the space, causing the perceived sound not only from the can but also from the echoes in the room.

After constructing the tool, we conducted the experiment with the following steps: 1) Stretch two cans along the length of the string to be used, 2) Place one can near the hearing senses and the other can as the source of sound, 3) Generate sound on the side of the second can, 4) Listen to how clearly the sound produced by the second can is heard on the first can, 5) Repeat the process with different sound propagation mediums, and 6) Record the noise results produced by each medium



Picture 2. Tin Phone Experiment

Result and Discussion

Data obtained after conducting the experiment, to determine the sound produced in different mediums are:

Table 1. Results of the experiment using tin can phones with nylon string medium.

Medium	Clarity of the sound produced		The sound heard		
	Clear	Unclear	Loud	Slow	Not Hears
Nylon String 1,5 m			✓		
Nylon String 3 m	✓		✓		
Nylon String 4,5 m	✓		✓		

Table 2. Results of the experiment using tin can phones with kite string medium.

Medium	Clarity of the sound produced		The sound heard		
	Clear	Not Clear	Loud	Slow	Not Hears
Kite String 1,5 m	✓		✓		

Kite String	✓	✓
3 m		
Kite String	✓	✓
4,5 m		

Table 3. Results of the experiment using tin can phones with wire medium.

Medium	Clarity of the sound produced		The sound heard		
	Clear	Not Clear	Loud	Slow	Not Hears
wire	✓		✓		
1,5 m					
wire	✓			✓	
3 m					
wire		✓	✓		
4,5 m					

From the results of the experiments we have carried out, we can compare the size of the sound produced by experimenting with tin telephones using knitted nylon thread, kite cord and copper wire. The sound produced by a tin telephone can travel through all three mediums, then be picked up by the ear so that we can hear what friends are saying.

The basic concept of the nature of vibration is that sound is produced by a vibrating source which often propagates through the surrounding medium, then is transmitted as a wave. String waves arise due to disturbances from the string, then the disturbance is propagated back to the string.

Based on the experiments carried out, sound can propagate because there is a propagating medium, namely a rope, the sound is produced because of sound waves propagating in the air. In

tin telephones sound waves can propagate through ropes (nylon thread, kite cord and wire). If the tension in the string medium is greater, the sound produced will be clearer when heard.

The tension of the string has a big influence on the sound produced, because when we stretch the string the sound produced is clear, whereas when we stretch the string the sound produced is not clear, very small or non-existent. When the rope is stretched, there are no sound waves from the sound source that propagate through the medium to the sound recipient (listener).

The length of the string (nylon thread and kite cord) matters, because if the string is longer the sound will be clearer and if the string is shorter the sound observed is clear but quiet. On the other hand, with a wire, the longer the wire used, the less clear the sound produced.

The mass density of a string greatly influences its propagation speed, on wires with a greater mass density than others, the propagation speed is small, while on nylon threads, the mass density is smaller, the propagation speed is greater, and on kites with the smallest mass density, the resulting propagation speed is fast. the biggest. Therefore, it can be concluded that the mass density is inversely proportional to the speed of propagation.

The disadvantage of this tool (tin phone) is that if we carry out experiments indoors, the sound we produce will echo throughout the room, thus affecting the sound being observed. Meanwhile, if we carry out an experiment outside, the sound from outside influences the sound results that we observe in the experiment. If the distance between the can and the ear is stretched, the sound observed will be clearer, compared to if we put the can to the ear.

Conclusion

The results of the research conducted on different tin can phones varied according to the type of string used. In the case of nylon thread and kite string, both produced clear and loud sounds even though the length of the medium was different. On the other hand, with copper wire, the resulting sound was less clear and quieter. The length of the string affects the clarity of the sound produced – as the string gets longer, the sound becomes louder. However, with wire, it's the opposite; as the wire gets longer, the produced sound becomes unclear. The sound produced by each medium differs due to the type of material used as the sound source. Additionally, the number of particles in each substance is also different. Sound propagates faster in solid media, followed by gases and liquids.

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