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Concept Analysis of Sound Wave Physics in Tabuhan Cave Rocks

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Abstract

Indonesia is a plural country with a diverse population and culture. Cultural diversity in Indonesia can be an important capital for the progress of the nation. One of them is the unique culture in Pacitan in the form of stones that can sound like the gamelan in Tabuhan Cave. Tabuhan Cave is a karst cave located at the western end of Pacitan and is included in 33 UNESCO sites. The purpose of this research is to analyze the physics concept of sound waves on the stone of Tabuhan Cave. The method used in this study is a qualitative method with data analysis techniques in the form of content analysis. The results of the analysis obtained are the physics of sound waves in the Tabuhan Cave rock caused by the rock structure and environmental conditions. The sound of the Tabuhan Cave stones has a frequency ranging from 900-1000 Hz and the sound intensity level is around -40 to -100 dB which is measured at different distances. The greater the distance, the smaller the frequency and intensity of the sounds of the Tabuhan Cave stones. So it can be concluded that there is a physics concept of sound waves on the Tabuhan Cave stone which is influenced by the characteristics of the stone, the position of the stone, the hitting point, and the distance used. The greater the distance from the Tabuhan Cave stone, the smaller the sound will be heard with the frequency and intensity that is increasingly small too.

Keywords: Sound, Stone, Art, Karst, Tabuhan Cave

INTRODUCTION

Tabuhan Cave has located 40 km from the center of Pacitan Regency, precisely in Wareng Village, Punung District, Pacitan Regency (Sakti, 2017). Based on Ridlo's research, (2015), Tabuhan Cave is a cave that offers beautiful views with a historical background. It is a cave inhabited by early humans. Besides that, in Tabuhan Cave there is also a stone tool workshop from tens of thousands of years ago which was marked by the discovery of Mollusk fossils and tooth fossils on the rock wall of the Cave. The attraction of the Tabuhan Cave is the stalagmites which can resonate to produce a sound like a set of gamelan with a melodious sound (Hawa Nurjannah et al., 2020). The sound of the gamelan that appears on the stone wall of the Tabuhan Cave is almost the same as the sound that arises on the stone wall of the Gong Cave. The sound comes from water droplets hitting the stalactites or stalagmites in the cave, resulting in an echo resembling a gamelan sound (Kemlu.go.id, 2022). Tabuhan Cave Gamelan art consists of musical instruments originating from the rock walls of Tabuhan Cave which consist of

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Kendang, Bonang, Gong, Kempul, Peneus, and Kenong instruments (Pratama & Winarko, 2018).

Cultural preservation is important so that culture can continue to be enjoyed and developed in the future, especially by preserving the younger generation through education. It has been stated in Law Number 20 of 2003 concerning the National Education System, Article 3 states that, national education functions in developing capabilities and forming dignified national character and civilization in the context of educating the nation's life. Education is a vessel that provides cultural values and knowledge to the younger generation to support cultural values and manage them properly so that they do not become extinct (Iswatiningsih, 2019).Beragamnya kebudayaan Indonesia dapat menjadi suatu bentuk kekuatan dan kekayaan serta aset negara yang perlu dilestarikan, salah satunya adalah budaya Musik Gua Tabuhan yang berada di Desa Wereng, Kecamatan Punung, Kabupaten Pacitan, Provinsi Jawa Timur. Musik Gua Tabuhan merupakan budaya hasil kreatifitas manusia dengan alam yang timbul di tengah masyarakat Pacitan. Kebudayaan tersebut muncul dikarenakan Pacitan terletak pada kawasan karst Gunungsewu yang berbatasan langsung dengan Kabupaten Wonogiri (Zulki Fahrudi & Wiratmoko, 2018). Kawasan ini merupakan bentang alam yang terjadi karena proses pelarutan karbonat atau batuan terlarut, yang menimbulkan relief dengan berbagai keunikan (Sari *et al.*, 2021).

Tabuhan Cave music arises because of the resonating stalactites and stalagmites which produce beautiful and melodious sounds which are often played at certain times (Karyawanto & Sarjoko, 2019). Tabuhan cave music is played accompanied by drums and traditional Javanese singers (Sinden) who sing Javanese songs (Hawa Nurjannah et al., 2020). However, as time went on there were several arts in Pacitan that were not performed enough, one of which was the Tabuhan Cave music and many still suspected that the sound of the Tabuhan Cave stones was related to mystical things that developed around it.

Physics is one of the most feared branches of science in school learning. One of them is the sound that is often considered difficult to understand. Sound is difficult to understand if it is only limited to theory because sound cannot be seen directly by the eye. Asyari & Murwaningrum, (2018), stated that, it is necessary to use media related to the environment and daily life so that understanding related to sound principles can be conveyed and able to add new experiences to students. In addition, learning physics in schools in general is still focused on material and learning in books only (Astuti & Bhakti, 2021).

METHODS

This research is qualitative research with data analysis using content analysis. Content analysis consists of six stages: unitizing, sampling, recording/coding, reducing, inferring, and narrating (Krippendorff, 2004). Data collection was carried out by observation, experimentation, documentation, and interviews with 6 informants. Experiments were carried out by measuring sound directly using a recorder which was then analyzed using the Wavepad Sound Editor software. Field observation was carried out by directly observing

the performance of the Tabuhan Cave stone gamelan in Tabuhan Cave. While documentation is done by collecting information sources and data that has been obtained. The resource persons in this study consisted of musicians, caretakers of Tabuhan Cave, Geopark experts, and residents. This study uses triangulation of sources to check the validity of the data obtained. Triangulation of resource persons is carried out by asking research sources regarding data, so that the data obtained is valid (Sugiyono, 2019). The resulting sound wave data in this study were analyzed using an application in the form of the Wavepad Sound Editor. Wavepad Sound Editor is an audio program and editor software used for recording or editing music, sound, and other audio recordings (Syafitri, 2015). In Kaba's research, (2020), the WavePad Sound Editor can be used to identify sound waves by entering the sound samples obtained and then processing them by transforming the sound using FFT. Changing sound using FFT is carried out to convert a time-domain sound signal into a frequency-domain sound signal so that the frequency and intensity of the sound produced in that sound can be known. The flow of this research design is illustrated in Figure 1 below.

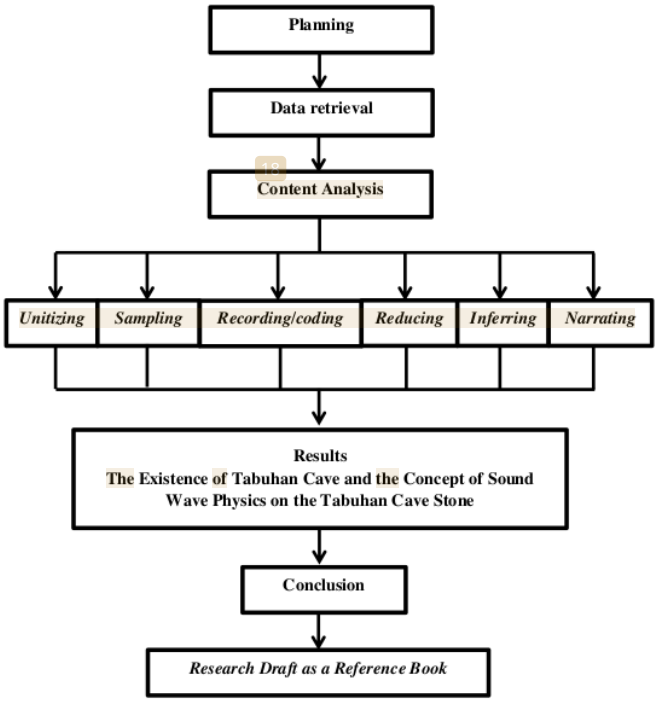


Figure 1. Research Flowchart

Unitizing is the stage where data is collected in the form of interview results, videos of Tabuhan Cave gamelan performances, and texts from literature studies. The results of the interviews in the form of voice data were

transcribed into text form, but for data in the form of videos, they could not be transcribed but instead became a support that could be viewed repeatedly. Then the text of the interview results and the text of the interview transcripts were collected for analysis. Sampling is at this stage a simplification of the data is carried out, by taking the data according to the text of the results of the literature study and the text of the interview transcript regarding the sound waves produced by the Tabuhan Cave stone. Recording/coding is the stage where the sound wave image corresponds to the sampled text and is given a symbol. At the reducing stage, the gamelan art components of Tabuhan Cave which are not in accordance with the concept of sound waves can be removed. Inferring is the data stage that has been obtained in the form of strokes and the sound of the gamelan art of Tabuhan Cave which contains the concept of sound waves and is re-analyzed according to the concept of physics. Narrating is at this stage the researcher makes the appropriate analysis results so that the information can be conveyed to the reader and the reader will benefit from the research being carried out.

RESULTS AND DISCUSSION

This study shows that there is a physics concept of sound waves in the Tabuhan Cave stone which is influenced by several factors such as the characteristics of the stone, the room of the cave, the point of impact, and the bat used. Tabuhan Cave is unique in that its stalactite stones can be played and produce sounds like gamelan. The rock can be played into a Javanese song so that it becomes a tourist attraction or is often referred to by the community as Tabuhan Cave rock music. Apart from that, Tabuhan Cave is a cave that offers beautiful views with a historical background. It is a cave inhabited by ancient humans. In addition, Tabuhan Cave also has a stone tool workshop from tens of thousands of years ago which was marked by the discovery of mollusk fossils and tooth fossils. on the stone wall of the cave.

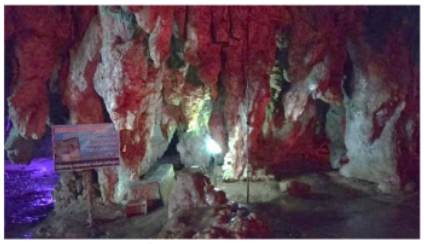
Tabuhan Cave rock music is played by hitting alternately and rhythmically with Tabuhan Cave stalactites using a wooden beater. Tabuhan Cave is one of the caves that is included in the Gunungsewu Karst area, where this area has 33 geological sites as UNESCO heritage. Because it is included in 33 UNESCO heritage geological sites and has a unique rock in it, maintenance of the cave at Tabuhan Cave needs to be done regularly so that it doesn't get damaged. Not only Tabuhan Cave. Most of the area of Pacitan Regency is in the form of limestone mountains which are a series of rows of Kidul (south) mountains, besides that, Pacitan Regency is a proven or mountainous area (Husni & Wildan, 2021). Pacitan Regency is often known as the City of 1001 Caves which has many caves in the UNESCO Global Geopark Network (GGN) karst landscape area (Sulistiani & Munawar, 2018).

Pacitan is one of the Gunung Sewu karst landscapes which has a 120 km long karst landscape from Gunungkidul to Pacitan. 2 million years ago this area was at a depth of 40 meters in the Indian Ocean and was lifted to the

surface so that a morphology such as hills, valleys, to topographic curves was formed (Natarina & Sachari, 2022). The formation of these topographical indentations also produces another topography in the form of caves, which are spread along the Gunung Sewu karst from Gunungkidul, Yogyakarta to Pacitan, East Java. The karst area is a typical landscape that occurs due to the process of dissolving carbonate or dissolved rock, so that a relief is formed in the rocky zone which dissolves quickly and there are underground rivers as large springs (Sari et al., 2021). Hertanto, (2021), said that the karst area in Pacitan has an area of approximately 310,982 km2 of the total area of Pacitan Regency. Based on the distribution and characteristics of the karst areas in Pacitan, Karst in Pacitan is divided into two, namely the western karst area and the eastern karst area, and includes several sub-regions located in the south such as Donorojo and Punung.

Tabuhan Cave rock music is played by six players, four of whom are beaters and two of whom are sinden or singers. When playing Tabuhan Cave rock music, technique and feel are needed to determine the right point of the strike so that the rhythm can become a melodious melody. Tabuhan Cave rock music is played using only two components, namely, rock stalactites and drums which are played rhythmically by the players and accompanied by two singers. Determination of the tone in Tabuhan Cave rock music is done by hitting it crosswise. Tabuhan Cave rock music has four stones used which consist of: gong stone, kenong stone, kempul stone, and successor stone. Stalactites and stalagmites themselves are formed by raindrops that fall directly onto the limestone and then seep down through the rock. Where it gradually becomes saturated with calcium carbonate as it dissolves the limestone it passes through, then when it reaches the open cave below, the calcium carbonate precipitates to form stalactites and stalagmites (NERC, 2022). Stalactites themselves are a part of the cave that hangs down from the ceiling and is formed drop by drop of water slowly through the cracks in the roof of the cave. Meanwhile, stalagmites are parts of the cave that grow upward from the bottom of the cave and is generally formed from water droplets from overhanging stalactites (Morgan, 1991).

Tabuhan Cave has two main rooms, namely the main hall at the front and the petilasan room at the back of the cave. The main hall of the Tabuhan Cave consists of several tourist sites, namely a group of gamelan stones which are usually played to entertain visitors who come, then there are seats for the audience near a group of gamelan stones, a spring that comes from dripping stalactites that are still alive, until there is a prehistoric relic discovered fossil at the entrance to Tabuhan Cave. Apart from that, in the main hall of the Tabuhan Cave, several others stones can sound but are not used in the Tabuhan Cave gamelan art. This is because the locations are far from each other, have almost the same pitch, and cannot be harmonized between one stone and another. Locations that are far apart are also very influential on the sound produced because the farther the location between the stones, the less clear the resulting rhythm will be.



a) Main Room

b) Hermitage Room

Picture 2 the Tabuhan Cave Room

The sound produced by the Tabuhan Cave stone is influenced by several natural and human factors around it. The Tabuhan Cave Stone which can be sounded and played is a stalactite stone that is dead and does not drip back or has no growth. In addition, the sound of wasp cave stone walls can be produced beautifully because they are hit in a cross manner by matching the hitting point and the song being sung. Usually, this beating is done by aligning the beaters with one another so that the sound or music produced is rhythmic like gamelan music in general.

Sound is a sound that is heard by the human sense of hearing. Sound can reach the sense of hearing due to things that stimulate the sense of hearing in the form of longitudinal waves (Giancoli, 2001). Sound can propagate due to the presence of a medium such as air, solid objects, and others. Sound cannot be heard when it is in a vacuum condition because in a vacuum condition, there is no air medium to propagate sound. The same goes for the sound of Tabuhan Cave stones. The sound of the Tabuhan Cave stone is a sound that propagates through a solid medium in the form of a solid but hollow rock structure. The sound of the Tabuhan Cave stone appears due to a vibration in the rock cavity, just like the strings on a guitar, violin, or drum. The Tabuhan Cave Stone used has a different sound because it has a different shape and size. The sound is called the theory of relict stress. Relict stress implies that the bouncing stones act like strings. When a string is limp there is no resonance, but a plucked string will give a variety of sounds depending on the level applied.

The phenomenon of sound in caves that often occurs is an echo. Reverberation is a phenomenon of reflected sound that is heard after the original sound is heard. In the phenomenon of this echo sound the distance tends to be not close together which can occur when the sound source and the reflected stone wall are at a great distance, such as sound on hillsides or caves. The loudness of sound that can be heard in a cave or phenomena in nature is caused by several influencing factors, including: a) the amplitude of the sound source; b) the distance between the sound source and the listener;

3) the resonance that occurs; and d) appropriate reflecting stone walls (Nurhayati, 2018).

The sound produced by the Tabuhan Cave stone is beautiful and rhythmic because the Tabuhan Cave itself has a type of acoustic cave room that can reflect sound. In addition, the stone that can be heard in Tabuhan Cave has a rock structure that is hollow inside so that it can support a resonance occur in it. Resonance in the Tabuhan Cave stone occurs due to the influence of the blow from the ganden used on the rock which causes the air in the rock cavity to vibrate and produce sound. Tabuhan Cave has the characteristics of a rock that is formed due to drips and deposits of calcium. Tabuhan Cave itself consists of 99% lime. This content is influenced by the condition of the soil around the cave which is composed of lime, magnesium, silicates, carbonates, and volcanic materials. In general, limestone contains 95% calcium carbonate calcite, 3% dolomite, and the rest is clay minerals (Apriliani et al., 2012). Limestone is a solid rock with a high calcium carbonate content with carbonate minerals associated with limestone, namely aragonite. These rocks at a certain time can turn into calcite rock (CaCo3) (Winonazada et al., 2020). The several types of rock formations around Tabuhan Cave are shown in table 1 below.

Table 1. Types of Rock Formations in Tabuhan Cave

Rock Name	Description
Nampol Formation	It consists of tuffaceous sandstone, sandstone, thin tuffaceous limestone, claystone, and lignite, interspersed with conglomerate and breccia. Nampol rock is about 50 m thick, and is a volcanic rock.
Wuni Formation	It consists of volcanic breccia, tuff, tuffaceous sandstone, lithic sandstone, and siltstone, interspersed with ignite and limestone. The Wuni Formation was deposited in a shallow to Ranston marine environment with a thickness of less than 50 m.
Jaten Formation	It consists of conglomerates, coarse to very coarse-grained sandstones, and mudstones with intercalations of lignite, carbon shale, and suff. This formation has terrestrial to transitional sediments with a thickness of about 100 m.

The sound of the Tabuhan Cave stone is also influenced by the different levels of violence on each stone. The hardness level of the stalactite stone itself is determined by the age of the stone where the longer the age of the calcite stone, the more it crystallizes and dies. Stones in the Tabuhan Cave that can produce relative sound have hundreds of years of age. The stone is an old and crystallized calcite stone. The sound on the Tabuhan Cave stone

is also influenced by the bat in the form of a ganden and the hitting point used. In the Tabuhan Cave stone, the process of making the sound comes from the couple's blows against the rock. When the ganden is hit on the rock, the particles on the rock wall vibrate and propagate. The vibration of the particles in the medium (stone) makes the air around it vibrate, this is what is called resonance. Tabuhan Cave has several stones that can produce sounds, namely a bunch of rocks in the middle of the main room of the Tabuhan cave with four types of stones that sound and several other stones at different locations. However, several stones apart from the cluster in the middle of the main room of Tabuhan Cave have never been used for rock music performances. This happens because the sound produced cannot form a rhythm with the other stones, besides that the sound produced tends to be smaller than the stones in a group. The wasp cave stones that sound in locations other than a bunch are not used also because the places are scattered and the shape of the roof or the reflection area tends to be concave, resulting in a bad reflected sound and making it difficult for the musicians to play and synchronize the rhythm of the music.

Tabuhan Cave has a room position that can support resonance. The hitting point on each stalactite stone used has a different hitting point from one stone to another. The striking point on the Tabuhan Cave stone has a different point of each stone which depends on the accuracy of the hollow part in the rock so that it can resonate. Batu Kempul itself has three striking points that are almost close together, namely two at the top and one at the bottom. In this kempul rock beating is done alternately and quickly by adjusting the song being sung. Then the gong has only one striking point like the gong instrument in general which has one striking point in the middle. On the gong stone of Tabuhan Cave, the point of impact is at the bottom of the hanging stalactite rock. The beating of this gong stone in a musical game is carried out loudly and follows the rhythm of the other stones because the gong stone is the determinant of the tempo of the song being sung. The kenong stone has a striking point which is almost the same as the gong stone, but in a lower position. The beating of the kenong stone is almost the same as the beating of a kenong musical instrument in general, but the kenong stone does not have another kenong so it only uses one kenong which is beaten alternately at the same point of strike. Apart from the kempul, gong, and kenong stones, there is one more stone that can make a sound, namely the successor stone. This successor stone is a stone that has different shape characteristics from the other stones because it tends to go hand in hand between stalactites with one another. In addition, the stalactite stones on this succession stone tend to be small compared to other stones and are in a low position. The beating of this successor stone is carried out with three points of impact and is played alternately by equalizing and harmonizing the tones played on Tabuhan Cave rock music. The following is an illustration of the point of impact on each stone:

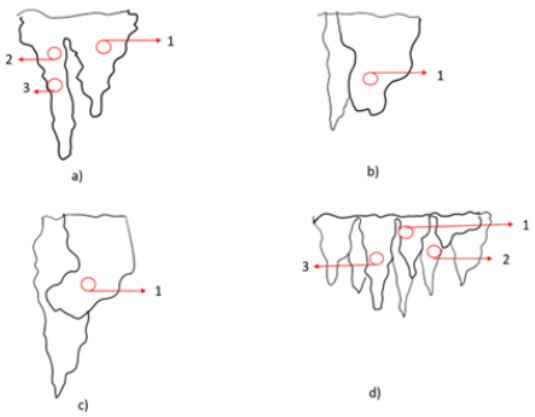


Figure 3. Strike points on a) Batu Kempul, b) Batu Gong, c) Batu Kenong, and d) Batu Successor

Sound is a longitudinal wave that is formed due to density and stretching in the gas medium (Tipler, 2001). The media capable of propagating waves are in the form of solids, liquids, and gases. The medium functions as a place to move energy from one place to another, so the wave is said to be a traveling wave. Sound waves have basic properties including (1) sound waves in the form of longitudinal mechanical waves, (2) sound propagates requiring an intermediary medium, (3) sound waves can be reflected, (4) sound waves can be refracted, (5) sound waves can be bending, (6) sound waves can be combined (Halliday et al., 2015). The following is an illustration of the sound waves in the sound of Tabuhan Cave stones:

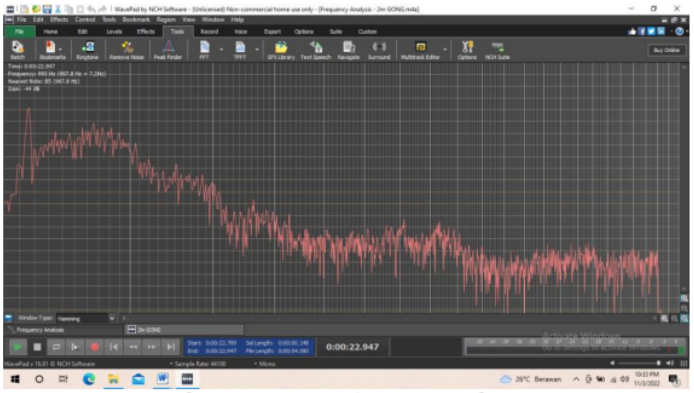


Figure 4 Sound waves of Tabuhan Cave stones

Based on the picture above, the wave in the picture illustrates that the wave propagates from a high sound intensity to a lower sound intensity. This is because the room conditions in Tabuhan Cave are wide with long distances and can spread sound in Tabuhan Cave.

Sound can spread up, down, or around the room. Sound can also bounce if it hits several surfaces before reaching the listener. This reflection is caused by the shape of the space and the character of the stone walls around it (Ambarwati, 2015). Kho, (2014) explains that sound has different characteristics according to the reflecting plane, such as on a flat plane the sound produced is uniform, while on a concave surface, the sound is collected, and on a convex surface the sound is spread by the field. The following is an illustration of sound reflection in several areas described in Figure 5.

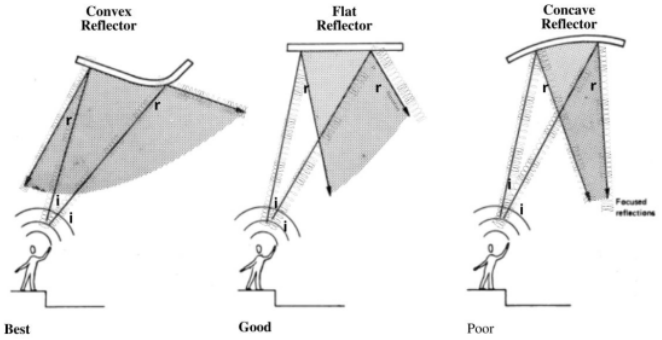


Figure 5 sound reflection field
Source: (Egan, 1972)

Tabuhan Cave has various types of reflection areas, namely a mixture of convex reflection areas, flat reflection areas, and concave reflection areas. This makes the sound produced by the Tabuhan Cave stone in it reflected well and can be heard beautifully, especially at the Tabuhan Cave rock music performance venue which has a convex reflective wall. The convex-shaped roof of the main hall of the Tabuhan Cave makes the sound produced from the beating of the Tabuhan Cave stones well heard because the sound produced by the stones can be reflected properly so that they can be heard clearly. As explained in Figure 5, the convex reflecting plane has the best ability to reflect and scatter sound compared to other types of reflecting surfaces.

The sound produced by the sound source can be heard by humans because of the frequency of the sound waves. Sound frequency is defined as the number of cycles per event at a certain time interval. The sound pitch which is the high and low of a sound is also affected by frequency. The higher the tone, the higher the frequency, and the higher the frequency, the shorter the wavelength (Hainen et al., 2005). The unit of frequency is hertz (Hz) or the number of wavelengths per second, where the faster the vibration, the higher the frequency of the waves produced. The following is the result of the

frequency and intensity of the sound of Tabuhan Cave stones at different distances.

Table 2. Average Frequency of Tabuhan Cave Stones

Stone Section	Distance (m)	Average frequency (Hz)
Gong	1	994,3
	2	991,6
	3	990,6
	4	990,6
Kenong	1	1037,6
	2	10016
	3	1003,6
	4	987,3
Kempul	1	1008,6
	2	1007
	3	1005,3
	4	987,3
Penerus	1	1002
	2	991,6
	3	991
	4	973,6

Tabuhan Cave rock music has four stones with different sizes and shapes that have different names. The four stones consist of gong stones, kenong stones, kempul stones, and successor stones. The mention of this stone is just an ordinary name from the players because the stone can make a sound like its name. For example, the kenong stone is a stone that has a sound like the sound of the kenong on Javanese musical instruments. When measured using the WavePad Sound Editor, it turns out that the gong stone has the lowest frequency compared to the other stones. In addition, when measurements are made at different distances, it turns out that the greater the distance, the smaller the frequency that can be heard by the observer. So that it can be scientifically proven through frequency measurements that the size of the Tabuhan Cave stone and the distance between the listener and the sound source also affect the sound heard. It has been explained that the larger the size, the lower the frequency. Where, high frequencies produce shorter wavelengths while low frequencies can produce longer wavelengths if they move at the same speed (Hainen et al., 2005). The following is an illustration of measuring the frequency and intensity of sound at different distances:

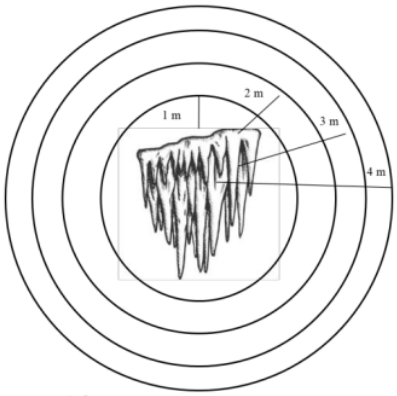


Figure 5. Illustration of Sound Frequency and Intensity Measurement

Measurement of sound frequency and intensity on the Tabuhan Cave stones was carried out with four measurement distances from the sound source in the form of a sounding group of Tabuhan Cave stones. These four distances consist of a distance of one meter, two meters, three meters, and four meters from the sound source. This distance affects the high and low frequency and intensity of the sound that can be heard at a certain distance around Tabuhan Cave. The high and low of a tone are affected by the frequency while the size of the sound volume is influenced by the intensity of the sound. Sound intensity is affected by power and cross-sectional area. When the power released is large, the intensity is also greater. However, when the distance from the sound source is getting farther, the sound that is heard will be smaller. The following is the average intensity level on the Tabuhan Cave stone,

Table 3 The average intensity level of Tabuhan Cave stones

Stone Section	Distance (m)	Average frequency (Hz)	Average Intensity Level (dB)
Gong	1	994,3	± -60,3
	2	991,6	± -54
	3	990,6	± -51,67
	4	990,6	± -48,6
Kenong	1	1037,6	± -53,3
	2	10016	± -50,3
	3	1003,6	± -43
	4	987,3	± -42,3
Kempul	1	1008,6	± -94
	2	1007	± -55,6
	3	1005,3	± -53,3
	4	987,3	± -54,6
Penerus	1	1002	± -107,3
	2	991,6	± -60
	3	991	± -55,3

4	973,6	± -47

In the Batu Tabuhan rock, the intensity of the sound depends on the player's power hitting the stone wall and the distance between the stone and the listener. Mathematically, the sound intensity is written as follows,

$$I = \frac{P}{A} = \frac{P}{4\pi R^2}$$

(Halliday et al., 2015).

Sound intensity also includes the physical quantity of sound waves. Sound intensity is a strong or weak sound that depends on the energy carried by the wave. In sound waves, the amplitude is related to how dispersed the molecules or particles are under conditions of density and density. The higher the wave amplitude, the more spread the strain and the wave density, and vice versa (Hainen et al., 2005). This relates to sound intensity which is defined as the average rate per unit area where there is a transfer of energy by waves to the surface. Sound intensity depends on the power and distance of the source. The sound intensity depends on the power and distance of the source. Based on the results of the intensity level in table 3, at a distance of ±1 meter from the source the intensity level is greater than at a distance of 2 meters, 3 meters, and 4 meters. The greater the distance between the sound source and the listener, the smaller the sound intensity that can be received by the listener. Based on this, the sound distance is inversely proportional to the frequency and intensity level that can be heard. In addition, the sound of the Tabuhan Cave stone is also influenced by the size of the Tabuhan Cave stone and the ganden used. The more balanced the size between the beater and the Tabuhan Cave stone that is hit, the greater the frequency that can be heard. This happens because if the bat used is relatively small, the sound of the gong stone that is heard will be slower. Affter all, it is not strong and does not match the size of the stone. The type of striking surface also affects the sound produced by the stones in Tabuhan Cave. The beater that is usually used is a wooden beater called ganden, when using a beater with other materials it sometimes doesn't make a sound or can even damage rocks. So that it is found that the sound of the Tabuhan Cave stone is influenced by factors in the stone and its surroundings such as the stone structure, the hitting point, the size of the stone to the type of beating material used must also be considered.

CONCLUSION

The physics concept of sound waves in the Tabuhan Cave stone can be found in the sound produced when a bat is struck against the rock wall of the cave. Some of the factors that influence the sound include the characteristics of the stone, the position and point of impact, the distance between the sound sources, and the size of the coupler used. The greater the distance between the sound source and the observer, the smaller the frequency and intensity of the sound that can be heard. Tabuhan Cave rock music is played with the aim of entertaining visitors who come to Tabuhan Cave and want to listen to rock music with Javanese campursari songs. As for some attitudes that can be taken from the existence of local culture, namely, as a reinforcement of a sense of nationalism which contains attitudes such as responsibility,

tolerance, to mutual cooperation. Another thing is that it can be used as a tool for social harmony amid during in the rapid development of the era. This research, it is only limited to the physics concept of sound waves from the Tabuhan Cave stone. For further research, it is hoped that there will be the development of other physics concepts in the Tabuhan Cave stone.

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