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PHYSICS IN THE TRADITIONAL MUSICAL INSTRUMENTS OF THE KALINGAS

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Abstract: *The basic requirements of knowledge are from the observant of the different traditional practices like the indigenous songs and dances blended with the use of the musical instruments. This study focused on the documentation of the different traditional and cultural dances of the Kalingas and its relation to Physics. Library techniques were used to gather related information to support the data. This study documented at least 8 –eight different traditional musical instruments and identified their uses and the purposes of the instruments in the culture of the Kalingas. It was found that the physical properties of each instrument have significant relations to Science of sound in Physics. The size, shape, length, and diameter affects the sounds produced by using the musical instruments.*

Keywords: *Sound, Traditional Songs and Dances, Musical instruments in Physics*

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BACKGROUND

The convention on biological diversity defines traditional knowledge as the knowledge ,innovations and practices of indigenous and local communities around the world. Traditional knowledge is transmitted orally and passed from generation to generation (CBC1992).

The basic component of any country's knowledge system is its traditional knowledge. One of these is the various aspects of their ethnic culture and their changing lifestyles. These are challenges that if not properly addressed may contribute to the disappearance of their own traditional culture and resultant loss of their cultural identity (htp//www.indigenous.educ.com.//).

Long before State-sponsored education systems were introduced, indigenous peoples had their own systems for managing their knowledge and educating their children. These systems, which are rooted in specific cultural contexts, have allowed them to survive as unique peoples. It is on this basis that indigenous peoples advocate for their right to control their own education systems (htp//www.indigenous.educ.com.//).

As described by the EMRIP: “To provide and receive education through their traditional methods of teaching and learning, and the right to integrate their own perspectives, cultures, beliefs, values and languages in mainstream education systems and institutions. As concluded in EMRIP, the right to education for indigenous peoples is a holistic concept incorporating mental, physical, spiritual, cultural and environmental dimensions (htp//www.indigenous.educ.com.//)

The inclusion of aspects of indigenous education requires us to acknowledge the existence of multiple forms of knowledge rather than one, standard, benchmark system(htp//www.indigenous.educ.com.//).

For indigenous learners and instructors, the inclusion of these methods into schools often enhances educational effectiveness by providing an education that adheres to an indigenous person’s own inherent perspectives, experiences, language, and customs, thereby making it easier for children to transition into the realm of adulthood. For non-indigenous students and teachers, such an education often has the effect of raising awareness of individual and collective traditions surrounding indigenous communities and peoples, thereby promoting

greater respect for and appreciation of various cultural realities(htp//www.indigenous.educ.com.//).

In terms of educational content, the inclusion of indigenous knowledge within curricula, instructional materials, and textbooks has largely the same effect on preparing students for the greater world as other educational systems, such as the Western model(htp//www.indigenous.educ.com.//).

There is value in including Indigenous knowledge and education in the public school system. Students of all backgrounds can benefit from being exposed to Indigenous education, as it can contribute to reducing racism in the classroom and increase the sense of community in a diverse group of students. There are a number of sensitive issues about what can be taught (and by whom) that require responsible consideration by non-Indigenous teachers who appreciate the importance of interjecting Indigenous perspectives into standard mainstream schools. Concerns about misappropriation of Indigenous ways of knowing without recognizing the plight of Indigenous Peoples and "giving back" to them are legitimate. Since most educators are non-Indigenous, and because Indigenous perspectives may offer solutions for current and future social and ecological problems, it is important to refer to Indigenous educators and agencies to develop curriculum and teaching strategies while at the same time encouraging activism on behalf of Indigenous Peoples. One way to bring authentic Indigenous experiences into the classroom is to work with community elders. They can help facilitate the incorporation of authentic knowledge and experiences into the classroom. Teachers must not shy away from bringing controversial subjects into the classroom. The history of Indigenous people should be delved into and developed fully. There are many age appropriate ways to do this, including the use of children's literature, media, and discussion. Individuals are recommended to reflect regularly on their teaching practice to become aware of areas of instruction in need of Indigenous perspectives(htp//www.indigenous.educ.com.//).

Traditional knowledge is also the social capital of the poor, their main asset in the struggle for survival, to produce food, to provide for shelter or to achieve control of their own lives.

The traditional musical instruments are on elements of the social tradition of the indigenous people that they inherit from their ancestor. These traditional instruments have varying

function and are heard on different occasions depending on the particular area within Kalinga.

The researchers are interested to conduct the study on the traditional musical instruments for the reason that, today, many traditional knowledge are at risk of becoming extinct because of rapidly changing natural environment and fast pacing economic, political and cultural changes on global scale. At present, due to the fast growing economic demands, the people as well as the culture are also changing rapidly. The strong influence of modernization has greatly affected the people in Kalinga. One of these is the various aspects of their ethnic culture and on their changing lifestyles.

These are challenges that if not properly addressed may contribute to the disappearance of their own traditional culture and resultant loss of their cultural identity. There is also a need to address the scarcity of documentation in school curriculum.

The purpose of this research is to document the traditional musical instruments used by the Kalinga tribe and to record and preserve the traditional instruments before they fall out of use. It also aimed to produce brochure that can be used as instructional material in the indigenized basic education curriculum. And more importantly, to find scientific linksof formal Physics concepts that blended with the structuring of the traditional musical instruments in order to integrate indigenous or local knowledge to formal classroom teaching. The ultimate goal was to develop initiatives towards harmonizing and integrating indigenous activities with documented formal science programs.

Most if not all students regard Physics as a very difficult subject, it is also regarded as boring for students who are not scientifically and mathematically inclined students. So, this is a challenge for all Physics teachers, to make their subject interesting and enjoyable. This will make students appreciate the lessons and it will be easier for them to understand.

The physics behind musical instruments is beautifully simple. The sounds made by musical instruments are possible because of standing waves, which come from the constructive interference between waves traveling in both directions along a string or a tube.

Researches on traditional musical instruments and its link to scientific concepts are not only very interesting topic but also an instructional valuable reference resource for the next generation.

OBJECTIVES

1. To document the traditional musical instruments of the Kalingas
2. To identify the scientific concepts which are related to the constructing and playing of the traditional musical instruments
3. To prepare a sample of an instructional material for the teaching of high school physics

SIGNIFICANCE OF THE STUDY

This study will be of benefit for both the teachers and the students in Physics. The students can easily understand the Physics concepts that are being taught by their teacher since it is based from their own experiences and from their material culture.

The teacher will not find difficulty in looking for a visual aid since the materials are readily available.

METHODOLOGY

The researchers used the historical method in conducting the study. The historical method describes the techniques such as documentation, observations and interview to the people concern.

Library technique was also used, like using of books, journals, and unpublished thesis in order to gather concepts that will support the data.

RESULTS AND DISCUSSION

I. Traditional Musical Instruments of the Kalingas

A. Gangsa (Gong)

Figure1.Gongs (Gangsa)

Description:

It is made up of bronze. A single handheld smooth surface with a narrow rim. A six gong ensemble consist of balbal reffering to the largest and lowest pitched gong, sobat or solbat, katlo (meaning) ("third"), kapat ("fourth"), umut and alungus, the smallest, which has the higest pitch. Flat gong ensembles like those made of bamboo have patterns that interlock and the varriying accents produce consecutive ringing tones or resultant melodies.

Tadok or Pattung is one way or style in playing the gangsa, where in, each player carry a gong and use a rounded stick made of wood to strike rhythmic patterns of ringing sounds. As the players play the tadok. They move in linear and circular formations with a group of female dancers. They form a straight line first to come up with a good rhythm and melody of the sound. Then, they enter in linear form, and then, they can have different formations, but, after each formation, they go back to their line to recover the normal rhythm and good melody.

Figur 2. Tadok/Pattung

Another way in playing the gong is the Toppayya. The players will arranged themselves in such a way that the first player will hold the largest gong. The size of the decreasess with ascending number of player. They form a straight line, then, they start striking their own gong.

In the toppaya, each player uses his bare palms to play corresponding combinations of accepted dampened and sliding strokes until there is ryhtm and melody of the sound produced.

Figure 3. Toppaya

Physics Concepts:

1. Diameter of the object affects the pitch of the sound.
2. Sound travels in straight line
3. Strength of striking the instrument/ Tension
4. Resonance

Sample Activity in the Classroom (Joe Lewis)

Lesson: Resonance

Materials Needed: 1 set Gong, pots

Procedures:

1. Tie a piece of string around the handles of each of the gong and pots. Make sure they are secure.
2. Tie each of the gong and pots to a strong support system. Make sure they are secure and will not fall during the experiment.
3. Once all of the gongs and pots are hanging safely and you are sure there is no chance of them falling, continue with step four.
4. Label each gong and pot A, B, C, etc..., until all the items are labeled.
5. Sing a steady loud note into each of the gong and pot for a few seconds. Record your observations for each letter on a chart.

CONCLUSION:

Did some of the gongs and pots resonate better than others? If so, which ones? Do you think that the materials in which the pots and gongs were made of make a difference in their resonating qualities? If so which ones?

Explanation:

The students should hear a sound reflecting from the gong. Because some materials resonate better than others, the students may not hear anything when they sing a single note into a pot.

B. Kullitong(bamboo tube zither)

Figure4. Kullitong/Kullibit(Bamboo zither)

Description:

A solo instrument made ofbamboo which has five to nine strings made by lifting up thinstrips from the hard skin of the bamboo tube itself. Small individual wooden bridges are inserted at both ends of each string.

How to play:

This is played by plucking the strings or use a rounded stick made of wood to strike the strings to produce sounds.

Physics Cocepts:

1. Material used in structuring the instruments
2. Length of the string affects the sound
3. Tightness of the string/ Tension
4. Diameter of the whole at the center of the instrument

This traditional musical instrument is like the guitar. In Physics, teachers always use the guitar as an example of instrument to illustrate factors that affect sound waves. So, to have practical application, this traditional musical instrument can be used so that students in the barrios can easily understand the concepts.

A typical guitar has six strings. These are all of the same length, and all under about the same tension, so why do they put out sound of different frequency? If you look at the different strings, they're of different sizes, so the mass/length of all the strings is different. The one at the bottom has the smallest mass/length, so it has the highest frequency. The strings increase in mass/length as you move up, so the top string, the heaviest, has the lowest frequency.

Tuning a guitar simply means setting the fundamental frequency of each string to the correct value. This is done by adjusting the tension in each string. If the tension is increased, the fundamental frequency increases; if the tension is reduced the frequency will decrease (htp//www.yale.edu/curriculum unit/2000)

To obtain different notes (i.e., different frequencies) from a string, the string's length is changed by pressing the string down until it touches a fret. This shortens a string, and the frequency will be increased. The percussive instruments produce pitch either by tightening the stretched material, or by using thinner or smaller pieces of material (htp//www.yale.edu/curriculum unit/2000)

C. Tongali(Mouth flute)

Figure 5. Tongali(mouth flute)

Description:

It is a solo instrument made of bamboo and has an average length of 60cm. It has finger holes and a thumb hole. The tongali is open at both ends, with a total of four finger holes; three in front, one at the back.

It is a solo instrument usually used by men for serenades or courting women, or merely for leisure and to pass the time or for relaxation.

Figure 6. How to play tongali

The player's lower lip is placed against the cut away surface as he blows directly to the hole. The finger holes and the thumb hole are carried at different intervals to produce different melodies.

Physics Cocepts:

1. Material used in structuring the instruments
2. Length of the instrument affects the sound
3. Diameter of the wholes at the center of the instrument

D. Saggeypo(bamboo pipe)

Figure 7. Saggeypo(bamboo pipe)

Description:

It is made of buho bamboo pipe that is consists of six pieces in a set.Its upper edge is cut away obliquely from the backside, and then cut away slightly from the frontside. It has a pattern that interlock. The different accents produce consecutive ringing tones. The longest size which is the number one and has the lowest pitch. It measures 8(eight) inches while the last number which has the higest pitch measures three inches.

This instrument is used in “peyaw”.This ritual is performed during planting season to drive away unseen spiritsthat they believed to affect the growth of crops.One of the purpose of the said ritual is to inform their town mates in order to prohibit visitors or outsiders to enter the town. This is “paliyaw” or “ngilin” or taboo for them.

The player's lower lip is placed against the cut away surface as he blows directly across the top. The different sounds are produced by blowing in different ways.

Figure8. How to play saggeypo

Physics Concepts:

1. Kind of material used in structuring the instruments
2. Length of the instruments

Wind instruments depend on the vibration of a column of air to produce sound. The column of air vibrates when wind is blown into or across an instrument. There are two types of wind instruments, brass and woodwind instruments. Brass instruments are played by vibrating the lips and pressing them against the mouthpiece of the instrument. This causes the air column to vibrate and create sound. Woodwind instruments such as the clarinet need a reed to make the air columns vibrate. The column of air vibrates in the flute and piccolo when air is blown across a hole. Higher or lower pitch can be produced in these instruments by making the air column shorter or longer (Joe Lewis)

E. Balingbing(bamboo buzzers)

Figure 9. Balingbing(Bamboo buzzers)

Description:

The instrument is constructed from a length of "buho" bamboo with a node at the bottom end. The upper half is shaped such that there are two tongues facing each other, while the bottom end acts as a resonator chamber.

The Balingbing are sounded to drive evil spirits away as people travel in the mountains specially for those "man–aalop" or "Mangangaso" and those who are going at the "ginubat" or mountain to search for a good area for "uma" or kaingin.

Figure 10. How to play balingbing

The instrument generates a buzzing sound from the sleet between the two tongues when the instrument is struck against the lower palm of the hand of the player. Furthermore, the sound can be altered by covering and uncovering a hole found on the bottom half of the instrument with the thumb of the hand which grasps the instrument.

Physics Concepts:

1. Kind of material used
2. Strength applied in striking/Tension

F. Pattungguk(quill-shaped tube)

Figure11. Pattungguk

Description

It is made of buho bamboo consist of six instruments in a set and has only one pointed at the topmost part with different sizes.

This instrument is used during the "ilom" this ritual is made when the first baby is seven months in the womb of the mother because at this point the baby is accepted as human being.

Figure12. How to play patungguk

The players firmly hold the instrument in their right and left hand and strike the wood on the ground to produce sounds.Furthermore, the sound can be altered by covering and uncovering a hole found on the bottom half of the instrument with the thumb of the hand grasping the instrument.

Physics Concept

1. Kind of material
2. Length of the material
3. Diameter of the holes

Sample of Activity in the Classroom(Joe Lewis)

Lesson: Frequencies of Different Sounds

Materials Needed: Bamboo, knife, others that are necessary

Procedures:

1. Make one set of each of the two traditional musical instruments;Balingbing(bamboo buzzers andPattungguk(quill-shaped tube)
2. Prepare all other material that are needed in order to play the musical instruments that you structured.

3. Set your group to play the instruments taking special attention on the arrangement of the size of the instruments and how to strike to come up with different sounds and rhythm.
4. Repeat number 3 until the concept is internalized and absorbed by the students.

CONCLUSION:

Did you notice a difference in the sound and how fast the instruments vibrated (frequency) when you had it plucked with different strength and energy?

Explain. Were there any differences between how fast the instrument vibrated (frequency) and sound of the different instruments?

Explain. What did you find out from this experiment?

Explanation

Vibrations caused the sounds produced by the musical instruments. The speed at which the vibrations occurred determines its frequency. The length of a vibrating object affects itS pitch. The materials an object is made of affects its frequency.

G. Ullibaw(bamboo jaw harp)

Figure13. Ullibaw(bamboo jaws harp)

Description

It is a type of jaw harp made from a hand carved piece of “buho” bamboo. This instrument is used in festive gathering for entertainment. It is also used by the male for courtship. The player firmly holds the instrument with the thumb and forefinger opposing each other, very near, but not interfering with the free end of the reed. This firm clamping of the bamboo adds to the mass of sound. Holding the instrument more loosely will diminish its volume. The part of the bamboo with the vibrating reed is placed horizontally between the lips. Various sounds can be created by the player while striking the projecting end with the

thumb or index finger. The cavity of the mouth serves as a resonator and by changing the shape and size of the mouth opening; the overtones can be changed, thus creating a melody. By strongly breathing in or out the sound can be changed as well. A limited melody of beautiful quality sounds are produced by increasing or decreasing the force of the air blown into the split opening and depending on the speed of the player's percussing finger strikes.

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Figure 14. Playing the Ullibaw

Physics Concepts:

1. Vibration of sound

2. Sound resonance
3. Tightness of the object
4. Diameter
5. Strength/ Tension

Sample of Classroom Activity(Joe Lewis)

Lesson: Making Sound Waves Visible

Materials Needed: Bamboo, Knife, bowl, water

Procedure:

1. Construct an Ullibaw(Bamboo jaw harp).
2. Prepare your group to play the musical instrument.
3. Strike the instruments and hold it in the air.
4. Strike the instrument and hold it in your mouth.
5. Fill the bowl almost to the top with water.
6. Strike the instrument and stick it into the bowl of water. Observe what happens to the water in the bowl.
7. Repeat the steps until the concept is clear and understood by students.

Conclusion:

What happened when you struck the instrument against your mouth? What happened when you struck the instrument against your mouth and placed it in the bowl of water?

Explanation:

Once the instrument is struck, it vibrates and produces sound. The vibration coming from the musical instrument causes the water to move out in wave formation.

H. Tongngatong(bamboo percussion instrument)

Figure15. Tongngatong

Description

It is made up of bamboo cut in various lengths. This has a pattern that interlock and the varying accents produce consecutive ringing tones or resultant melodies. A five or six tongatong ensemble consist of "umula" (first)reffering to the longest size and lowest pitched, "kumadwa", second, "kumatlo" third, "kumapat" fourth and the "anungus" which is the highest pitch.

This is used by the Kalinga people to communicate with spirits during "chomchomog" house blessings and during "gabbok" This ritual is performed not only to introduce the baby to the "kekeyaching" or the good spirits but also to inform everybody that a new person has been added to the community. In this ritual the men play the tongatong as the "mainsig" prays to "kabunyan" saying these words "we offer you our thanks for a new person had been added to our community."

It is also used in different occasions or entertainment.

Each player holds the upper most part of a tongatong in their left hand as they hit the tongatong on the ground as their right palm to cover the hole at the end top in an alternate way to produce different melodies.

Figure16. Playing the Tongatong

Physics Concepts:

1. Kind of material
2. Length of the object
3. Medium

Sample of Activity in the Classroom(Joe Lewis)

Lesson: Making Musical Sounds by Changing Pitch

Materials Needed: Bamboo, Knife,

Procedures:

1. Prepare 6 pieces of Tongngatong (bamboo percussion instrument) of different length.
2. Prepare your group to play the instruments. Arrange your selves in such a way that the first member will hold the longest, then follow decreasing length of instrument until the 6th member.
3. Start tapping the instrument on the ground until a good rhythm and sound is produced.
4. Repeat the steps until concepts are clear and applied.

Conclusion

What did you notice about the pitch coming from the instrument as you tapped on each one of them in descending order? Was there a difference in the pitch when you tapped on the instrument? Explain your answers.

Explanation:

Different sounds are produced by changing the length of the object, or air volume through which the air vibrate. Shorter air columns produce higher pitches than longer air columns. When the bamboo instruments are tapped, they react in the same manner.

The Science of Sound and Instruments

Much of what we know about music and how tension, length, and thickness affect the frequency of vibrating strings can be accredited to the Greek philosopher Pythagoras. He discovered that if one string vibrates with twice the frequency of an identical string, we hear the higher frequency as once octave higher in pitch than the lower frequency (Joe Lewis)

As we investigate musical instruments, we will discover that some type of vibrating system produces all musical sounds. The strings on the guitar, or the air column in the clarinet, and the head of the drum are examples of vibrating systems. The vibrating systems on most musical instrument are made up of two or more vibrating systems working together to produce sounds loud enough to be heard by the human ear.

Conclusions:

Traditional musical instruments produce sound waves when the strings are vibrated. There are factors that affect the pitch of string instruments:

- Diameter of the string. The lesser the diameter, the higher the pitch.
- Length of the string. The longer the string, the lower the pitch.
- Tightness of the string. The tighter the string, the higher the pitch.
- Kind of material it is made of. Lighter materials are better for sound production (Physics for Health and Science Manual)

Wind instruments produce sounds by making air column vibrate. The pitch of the instrument is changed by changing the length of the air column and diameter. The longer the air column with smaller diameter, the higher the pitch, the wider the diameter of the musical instrument, the lower the pitch of the sound(Physics for Health and Science Manual) These Physics concepts are applied in structuring and playing the traditional musical instruments of the Kalingas.

RECOMMENDATIONS:

The inclusion of indigenous knowledge within curricula, instructional materials, and textbooks has largely the same effect on preparing students for the greater world as other educational systems, such as the Western model.

It is then recommended that there is value in including Indigenous knowledge and education in the public school system. Students of all backgrounds can benefit from being exposed to Indigenous education, as it can contribute to clearer understanding and appreciation of the subject matter. They will also find practical applications of the concepts in their own activities.

BIBLIOGRAPHY

1. Buasen, C. (2011.) Education in the context of Philippine indigenous peoples: A synopsis of engagements. Retrieved from http://www.
2. ncip.gov.ph/CentralOffice/OfficeonEducationCultureandHealth/Educationinthe ContextofPhilippineIP.aspx.
3. Department of Education Order No. 62, series of 2011.Adopting the National Indigenous Peoples (IP) Education Policy Framework.
4. Department of Education Order No. 101, series of 2010. The Alternative Learning System (ALS) Curriculum for Indigenous Peoples (IPs) Education.
5. Department of Education Order No. 74, series of 2009 Institutionalization of Mother-Tongue Based Multilingual Education

6. Department of Education–Bureau of Alternative Learning System [BALS] (2006) Development of the Indigenous Peoples Education (Vols. 1-2)
7. Lapus, J.A. (2008, November). The education system facing the challenge of the 21st century – Philippines (Paper presented at a UNESCO conference in Geneva, Switzerland, November 25-28, 2008)
8. Lewi, Joe, The Science of Sound and Musical Instruments, htp//www.yale.edu/curriculum unit/2000
9. Miller, Dayton Clarence.The Science of Musical Sounds. The Macmillan Company, New York (1976).
10. ibe.unesco.org/National_Reports/ICE_2008/philippines_NR08.pdf NCIP. 2002-2010. Annual Reports
11. NCIP Administrative Order No. 1 Series of 1998 – Rules and regulations implementing Republic Act 8371 otherwise known as "The Indigenous Peoples' Rights Act of 1997" Implementing Rules and Regulations (IRR) of the IPRA
12. Richardson, Edward Gick. Sound: A Physical Science Textbook. Arnold Press, London (1953).
13. Wood, Robert. Sound Fundamentals: Funtastic Science Activities for Kids. Chelsea House Publishers, Philadelphia (1999).