Experimental Construction of Kulujegwu Musical Instruments as a Diatonic Woodblock

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Abstract

This paper aims to examine the invention of kulujegwu's musical instrument. The kulujegwu instrument is an innovative creation that uses woodblocks to produce a diatonic sound. The goal of this research is to develop sets of woodblocks that sound diatonic, serving as an accompaniment to an orchestral instrument. The study employed an ethnographic and experimental research design, including in-depth interviews with woodworkers, machinery operators, and sawmill dealers from various parts of the state. It is noted that detailed research on the facets of constructing kulujegwu instruments is lacking. The paper concludes that kulujegwu functions as a foundation for providing knowledge to other researchers in the field of musical instrument technology. It will serve as a resource and means of obtaining information on musical instrument construction.

Keywords: kulujegwu, Diatonic, Woodblock, Construction, Experimental, and Musical Instrument.

Overview of Kulujegwu Musical Instrument

Kulujegwu reflects the inventor's concept of identity. Kuluje is the inventor's name, while egwu is a musical term in the Ukwuani language. Kulujegwu adopts the idea of identity, as noted by Adekola (2018:545). Some African musical instruments have undergone various renovations and recreations. The researcher aims to innovate the traditional woodblock to produce diatonic sounds and facilitate the playing of simple songs for ensemble performances. The sound produced can be either high or low in volume, depending on the strength of the performer's actuation.

The main goal of this study is to develop kulujegwu as a suitable musical instrument for orchestral settings. Over the years, the construction of the diatonic woodblock has not received enough attention, despite being an indigenous musical instrument in many cultures. This study aims to address that gap by focusing on transforming a single-tone woodblock into a seven-tone instrument, allowing it to fit into orchestral or ensemble performances.

Diatonic woodblock

From the history of a woodblock, it is described as a small slit drum held in one hand and played with the other. Kuluje (2023:271) remarked that.

> *Diatonic woodblocks are constructed with specific measurements to ensure they produce different pitches and tonal qualities, arranged manually according to each tone.*

According to Montgu (2002:1), "A woodblock which is also spelled as two words, wood and block." It is a small slit instrument made from pieces of chipped wood, designed to function as a tempo or metronome. The terms 'wood' and 'block' describe an instrument created by shaping wood to resemble a block. Although the woodblock originated in Chinese musical instrument traditions, it is also common among the Igbo people of Nigeria. Generally, musical instruments are crafted from various materials and come in different styles and shapes. Some of these materials include glass, animal bones, metal, brass, bamboo, animal skins (membranes), horsehair, and animal horns. Other materials such as wood, rubber, steel, plastic, iron, and cast metal vary across cultures. In the case of kulujegwu, the materials used for construction include wood, iron, and damper rubber, which was used for the mallet. This shows that borrowing materials for making musical instruments is a common practice.

Generally, woodblock prints are made in various sizes and shapes, which is why they produce different tone qualities. If the mortise resonator becomes wider, the pitch produced will be lower, while the frequency increases as the instrument reverberates. This explains why woodblocks have different pitches depending on the mortising and the side struck. “The classification of woodblock is also based on the shape, which includes the following: canoe shape and block shape.

For innovation, the researcher constructs a kulujegwu instrument that sounds diatonic in the key of C major, using a mallet for easy playing. A diatonic scale is also known as (heptatonic), depending on the terminology. It consists of seven different tones arranged sequentially (Randel, 1969: 226). A diatonic scale can be in major, minor, or modal forms. Musical modes generally refer to scales of different structures, including Dorian, Lydian, Phrygian, Mixolydian, Locrian, and Aeolian. Kulujegwu's instrument is mainly built in the C major scale to produce diatonic notes and three additional tones. The woodblocks are arranged in tetra-chords, with lower tetra-chord doh–re–me–fah and higher tetra-chord soh–lah–te–doh. The other three notes can be either a preceding note above or below the tonic, depending on the music or performer. The researcher also constructs three additional woodblocks to play the dominant, submediant, and leading notes.

The researcher arranged the woodblocks accordingly for easy performance. Dayirmiter (2013) stated that a diatonic scale is any scale that contains five whole steps or full tones and two half steps or semitones, but in this case, the kulujegwu musical instrument is arranged in tetra-chords. Since the diatonic scale is derived from a chromatic scale, every note that makes up the diatonic scale is found in a chromatic scale. The researcher discovered how to identify the diatonic scale within the chromatic scale. In music, the diatonic scale is frequently used as a common scale by most musicians, whether they are beginners or intermediates. The main difference between chromatic and diatonic scales is the number of notes each can have. The chromatic scale has twelve notes, while the diatonic scale consists of seven notes, including two half notes and five whole notes. The diatonic scale sounds natural to the ear. According to Stephen (2018), the diatonic scale is called the natural scale. When musical instruments are played in a diatonic scale, they sound most natural to the ear. The Greek word for ‘diatonic’ is diatonikos.

Experimental construction of Kulujegwu

The experimental construction of kulujegwu is known as a self-resonating body; when the surface is struck, the instrument causes reverberation, and a penetrating sound is heard above other musical instruments of the ensemble when they are played together. The instrument comprises a set of seven tuned woodblocks that are assembled on a rack and an iron stand. The instrument is constructed to solo songs and play simple harmonies. Kulujegwu's instrument can be adjusted for

easier performance. The instrument is constructed and mounted on a wooden cabinet or frame and played with two sticks. The study, therefore, investigates the process of constructing a seven-tone woodblock and how artificial Intelligence has impacted the technological construction of the kulujegwu by making the woodblock sound diatonic. The researcher's experiment was based on the seasoning method, suitable for the instrument to reverberate. Data were also collected from Osun state, Giramu at Orita area, where all kinds of wooden instrument works are done.

The researcher philosophically experimented with different woods for the construction of the instrument. On this philosophy, the wood was seasoned to remove moisture content. Kulujegwu musical instrument was first seen as an art and science in reality, just like the xylophone instrument, where the slabs are systematically arranged to play a simple melody, either in chromatic or diatonic, when the slabs are struck with a stick. On this note, the instrument is regarded as the identical principle of philosophy.

Wood Used for Making Kulujegwu

Almost all boats were made of wood. Wood is one of the most multi-purpose timbers widely used globally, whether for making musical instruments or building houses. Hardwood is preferred for constructing instruments because it contains many chemical components that enhance durability and tone quality. Hardwood can produce a higher-pitched sound compared to softwoods. Kulujewu is made from wooden material, so wood is an organic substance derived from trees with a fibrous, anisotropic, and heterogeneous texture (Kuluje, 2021:18).

Woods are specifically used to craft various types of African musical instruments. One of the ancient slit instruments is made from wooden materials; the researcher used redwood to create the musical instrument. Since instruments began being made with bones, horse tails, and animal skins, wood has been used to hold them together or to separate the mechanisms. Wood also plays a significant role in the construction of musical instruments since the late 19th century. There are different types of wood used in making woodblock or other idiophone instruments. All types of wood are categorized into the following:

Hard-wood
Soft-wood

Hard-wood

Any tree that does not produce chutes is a source of hardwood and can be used for making musical instruments. The scientific term for such woods is often referred to as angiosperms or deciduous wood. Most hardwood trees produce leaves and seeds. For example: rose oak, maple, cherry, mahogany, and walnut, etc. Although several species of hardwood are well known for their spectacular and distinctive qualities. Hardwoods are stronger than softwoods. Examples of hardwoods that can be alternately used to construct woodblocks include:

i. Rose
ii. Mahogany
iii. Iroko
iv. Ebony

According to Metaxtech (2024), "Rosewood timber comes from redwood trees, and the red colour comes from the same timber that gives it resistance to insects and decay. This is the reason organologists often used rosewood for producing slit drums, woodblocks, xylophones, and slabs. Other types of wood are naturally seasoned and do not decay. Redwood trees are commonly used for natural products like creams, chemicals, mortar, and also for making musical instruments such as xylophones, slit-drums, and temple-blocks (or woodblocks).

Rosewood timber is well-known for its deep red color. The reason why musical instrument makers choose redwood for manufacturing instruments is not due to its hardness, but rather its stability, durability, and natural ability to resonate; it can also withstand harsh weather, even on the hottest, sunniest, or rainiest days. More importantly, redwood is ideal for making all kinds of musical instruments. Here are some points to consider regarding redwood.

- Redwood is a durable material often used in the countryside, known for resisting distortion and piercing.
- It is brighter than many woods; it can be easily drilled with standard woodworking tools and can be effortlessly harvested from its tree.
- It has natural chemical components that help to make it long-lasting and faultless for outdoor usage.
- It also resists insects from decaying naturally.

- It is recyclable, renewable, sustainable, and cleaner to crop than its engineered "choices.
- It has a high level of reverberation.

Additionally, several timbers classified as hardwoods come from non-deciduous trees, such as bamboo and raffia palm. Although technically called monocotyledons, these plants are often grouped as hardwoods because they share many similar traits. Bamboo and palm trees can sometimes be included in the next category of manufactured wood. Hardwoods (from deciduous trees) shed their leaves in autumn (harmattan), with examples including oak, mahogany, beech, and birch.

Mahogany Wood

The mahogany tree turns reddish brown at maturity. It is a tall evergreen tree and a type of hardwood often used for making mallets, though it is not commonly used in musical instruments because its resonator tends to be less durable and less reverberant. Despite this, its refinements are done to a precise, shiny finish. Mahogany wood is valued for its tone, and many guitarists in ancient times favored it because it has been recycled to create some of the most iconic musical instruments ever played. It is used to make the back and covering of the entire body of an acoustic guitar. It is also used for the necks and bodies of other stringed instruments more than any other type of wood (Watson, 2024). Mahogany wood is also quite good for making the sound box of any musical instrument, including its sound resonator.

Iroko Wood

According to history, ironwood trees such as iroko originate from a species of tree that thrives across most of Eastern and Southern Australia. Iroko is called uloho in the Urhobo language, ọ̀jị̀ in the Igbo language, and asodum in the Kwa languages of Ghana. The wood is used for various external and internal purposes, including domestic flooring, boat making, outdoor gates, and furniture. Since the late 1990s, iroko wood has been used to make the wooden boards of musical instruments because of its active sound-generating qualities (Wikipedia, 2024). Examples of musical instruments made from iroko wood in Igbo land include ngedegwu, a xylophone made of timbers placed on a plantain tree for its resonator;

ekwe, a well-known slit drum; and oja, a wooden five-hole flute recognized in Igbo land (Basu, 2018). Some organologists specialize in making the above-listed musical instruments. Musicians, especially instrumentalists in Igbo land, like most Yoruba musicians, earn their living by playing these instruments at ceremonies and traditional events.

Soft-Wood

Softwoods are not necessarily softer than hardwoods; several hardwoods are softer than others. Watson (2024) affirms that "gymnosperm trees are softwood such as conifers." Soft wooden trees produce soft lumber, which is a wood product used in making the action of upright pianos and grand pianos. Conifer trees, also known as Gymnosperms, are any trees that have cones and bear seeds. Pine, cedar, fir, spruce, and redwood are a few examples of common softwood trees used in furniture making, carpentry, and other related fields. Softwoods come from coniferous trees, trees whose cones and needles persist all year round.

Cedar

Cedar is the common name for plants or trees in the genus Cedrus. Historically, cedar has been renowned for making some of the best acoustic guitars in the world. It is used for the soundboards of guitars because of its excellent acoustic properties. Cedar helps a guitar reverberate well due to its high-quality sound production. It is equally effective for enhancing the sound of electric guitars, especially through a wooden soundboard resonator used worldwide. Cedar wood is considered one of the finest choices for constructing classic guitar necks. It is resistant to environmental changes and combines strength with lightness. Additionally, cedar wood has a rich, resonant tone and a pleasant aroma during construction (Wiki, 2022).

Pine Wood

Pine trees are ancient trees that grow twisting branches, sprigging leaf pointers, and pinecone scales arranged in Fibonacci ratios. The area with the most pines is thick and rugged, though some species have thin, peeling bark.

Spruce Wood

Spruce wood is another example of a soft, lightweight wood that has strength and elastic properties, with insulation inside for added lightness. Spruce wood is often used to make soundboards for instruments such as lutes, violins, harpsichords, guitars, and pianos.

Construction of Kulujegwu Musical Instruments

For the construction of the kulujegwu, the researcher tested two different types of design patterns: structural and creative.

- The simple technique or decoupling method, in which construction moves from one stage to the next, is the creational design pattern for building a woodblock. Harvesting wood from a tree is the first stage. The second stage is seasoning. The third stage is cutting wood into different sizes. The fourth stage is mortising the wood. The fifth stage is drilling. The sixth stage is smoothing or adding finishing touches. Making the diatonic woodblock required the use of con-wood and mahogany wood by the researcher. Table saws, jigsaws, mortising machines, stationary drilling machines, portable drilling hand tools, and sanders were employed to complete the instrument's design. The researcher proceeded to a sawmill where wood is sold to acquire some more to complete the order more quickly. The researcher then seasoned the wood for roughly fifteen working days to ensure it dried properly. He measured the wood with a measuring tape and then cut it into different sizes after mortising it to reduce weight or thickness.
- Structural design pattern: After applying the final touches to the structure, the structural pattern comes into play. Its main responsibility is to assemble the woodblocks so that the structure is solid and effective. The structure also enhances the instrument's aesthetics. It showcases the diatonic woodblock's final appearance.

An Analysis of the Kulujegwu in a Diatonic Scale

The woodblock is based on a diatonic scale; therefore, it is arranged in seven successive notes in order: C, D, E, F, G, A, and B. Simple solo melodies, choruses, and a seven-note scale are all played on a diatonic woodblock. The device is designed to mimic the white keys of a piano keyboard, allowing it to reproduce sounds corresponding to the named notes. For examination and to improve

scholarly orchestral performances, the researcher provided details such as how to replicate the construction of the diatonic woodblock. Because it can only produce seven pitches, the key and notes of the diatonic woodblock cannot be altered. The researcher attempted to divide the woodblock into lower and upper tetrachords, which form the entire scale.

Kulujegwu's Cabinet Construction and Design

The researcher constructed an iron cabinet and a stand to carry the entire woodblocks. Each cabinet has a foam to dampen the woodblock when struck or played. The instrument acts as a resonating body, so there is no need to build an external resonating chamber for sound production. By mortising the hollow side of the wood, the resonator is formed, and when struck, it produces sound. Its structure is made of wood that is drilled to create a self-resonating body and mortised to reduce thickness for easier portability. The research involved building an iron rack capable of holding the entire woodblock. According to the design, the woodblocks are arranged in a tetra-chord pattern, with three additional rack spaces for extra notes if needed. Underneath the cabinet, there is an adjustable stand with three bracket legs that can be raised or lowered depending on the performer's height.



Fig 1. Photo of Kulujegwu's Cabinet and Stand

Construction Stages of Kulujegwu in a Diatonic Scale

The researcher established a format for construction. He began by sorting wood, seasoning, mortising, creating the iron cabinet/rack, and adding finishing touches.

Wood Sorting

The researcher looked for wood to build the kulujegwu musical instrument. During fieldwork, he visited several sawmills and spoke with lumbermen. Among those he interviewed was Mr. Akpan Isaac, a professional woodworker from Eku, Delta.



Figure 2. The Researcher Selecting the Wood for the Construction

The researcher asked the following questions: first, where can I find rosewood? Second, how can I treat the wood to improve its durability? Third, what seasoning technique is best for hardwood? Lastly, how can I mortise the wood to my liking? When the interviewee appeared tired, the interviewer stopped the interview to prevent causing discomfort for future interactions.

Seasoning

Natural seasoning is considered the best method for preparing wooden musical instruments. What do I mean by natural seasoning? This is a process where wood is exposed to air and sunlight. Sometimes, the wood is soaked in water before natural seasoning. As Sahoo (2022) explains, air seasoning involves stacking wood

logs in a shed layer, while water seasoning means soaking wood in water to remove sap. Although natural methods are, by definition, natural, they are often preferred over artificial processes because they yield good results, even if they take longer.

Artificial seasoning, although often unreliable, is used by local musical instrument makers to produce quick results. These artificial methods include electrical, chemical, and kiln seasonings. Unlike kiln seasoning, where wood is exposed to hot air, boiling seasoning involves submerging the wood in water for about 4 hours. Electrical seasoning uses devices like electric heaters or ovens, while chemical seasoning dehydrates the wood by soaking it in a salt solution for a set period.

Care and Maintenance of the Instrument

Each musical instrument comes with a manual or guide that instructs the user on how to use, maintain, play, and service it. The instrument has been protected against decay, rodents, pests, and other animals that might consume the wood. The researcher combined various soluble chemical solutions, which he then applied during the seasoning process. No matter how long the instrument has been around, the solvent can kill any rodent. Due to weather changes, the researcher reapplied the solvent after a year to ensure proper maintenance. Finally, the instrument was placed on a pedestal on top of its cabinet. Generally, water is harmful to all kinds of musical instruments because moisture or liquids can easily damage the instrument or destroy the sound resonator. The Kulujegwu musical instrument should be stored in a cool, dry place, preferably indoors. Avoid using iron to strike the resonating body of the instrument; instead, use a drumstick. Additionally, avoid dropping the instrument to the floor, as this can cause damage or detune the instrument. The researcher then sprayed varnish on the stand and cabinet to prevent rusting. The stand also received its solvent treatment applied to the cabinet.



Fig 4. Diagram of Kulujegwu

He constructed two different types of beaters that could be used to play the instrument. To make the instrument sound tonal and prevent sound distortion during play, the beater's head is covered in rubber and foam. Heavy sunlight should be avoided because it could alter the instrument's key and tone. However, the chemical solvent also helped seal the final seasoning.

Kulujegwu as a Musical Instrument

Every musical instrument relies on the material used to make it; each has its resonator and a unique playing technique. The kulujegwu instrument is played by striking a set of tuned woodblocks with a beater or mallet. The cabinet was constructed strong enough to hold the entire set of woodblocks whether sitting or standing. In conclusion, the following is a summary of the study's findings.

i. The construction of kulujegwu revealed that rose and mahogany wood can be used to make the instrument.
ii. According to the study, transitioning from one tone to diatonic woodblocks was made possible.

iii. Findings showed that modern machines are more effective than manual tools in producing Kulujegwu.
iv. The study demonstrates that patience is essential for innovation
v. According to the study, a solid theory is developed to explain how the instrument's tones and semitones are produced and modified.
vi. Findings show that a mixture of sniper and diesel is used on the instrument to protect it from wood rot, termites, carpenter ants, and bees.
vii. Findings indicate that increasing the length of each hole by 1cm lowers the pitch and tone by a semitone. Therefore, a hole with a 1cm scoop is equivalent to lowering the pitch by one semitone.
viii. The researcher's theory indicates that the longer the resonator, the lower the pitch and the higher the frequency, while the shorter the resonator produces a higher pitch and a lower frequency.

Conclusion

The researcher shows how to create a woodblock instrument that plays a diatonic scale; change is the only constant in life. The innovative study aims to enhance musical instruments in Africa and worldwide. African musical instruments must be adapted through exploration to thrive in the modern era. Kulujegwu are built in stages, starting with cutting, mortising, and smoothing the wood, followed by constructing the stand and cabinet that hold all the woodblocks, and finally spraying and treating the instrument and cabinet.

Creating a diatonic woodblock qualifies this study as original research. To meet modern musical instrument standards, woodblocks have been innovated. The study examines both the musical and non-musical roles of the instrument, along with construction materials and tools. Interviews with woodworkers and lumbermen were essential to discuss the use of modern machinery, wood seasoning techniques, and wood treatment and preservation. An in-depth analysis of the building process was also conducted. These interviews and observations were documented with photographs and videos; the construction process was compiled by integrating these records, forming a key part of the research.

The construction of kulujegwu was linked to that of Hertz. Where the frequency of A is 440 Hz, the design of each tone and semitone was intended to be calculated

scientifically, side by side. The instrument's design includes one octave and three notes of a diatonic scale; it cannot play music with a full chromatic scale, and within the limits of this study, the researcher was unable to develop a suitable scientific mortising method. The instrument is restricted to one octave and a three-note diatonic scale; therefore, it cannot perform melodies with accidentals and ornaments. Finally, the instrument's pitch range spans from G4 to C5, as it mimics the white keys of a piano.

The research has provided a crucial component or structure for African traditional instruments, enabling them to perform extra musical functions and enhance performances that previously lacked such features. As a result, the study gains credibility as a reliable source that will influence how our traditional music is performed in the future and encourage research in related areas such as musical instrument design.

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