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Analysis of Frequency and Intensity Levels of Sound Waves in the Bedana Traditional Dance Music of Lampung Using an Ethnoscience Approach

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Abstract: This study analyzes the frequency and intensity levels of sound waves produced by musical instruments in the Bedana traditional dance of Lampung. An ethnoscience approach is employed, integrating cultural and scientific perspectives to examine sound phenomena in the local context. Data were gathered through sound frequency and intensity measurements using advanced audio analysis software, complemented by qualitative cultural observations. The results reveal distinct frequency variations among instruments, contributing to the dance's harmonic expression. Notably, statistical tests indicate significance, reinforcing the hypothesis regarding the unique acoustic properties of each instrument. This research underscores the importance of ethnoscience in cultural conservation and traditional arts education, offering insights for future ethnomusicological studies and cultural preservation initiatives.

Keywords: Ethnoscience; Musical Instruments; Sound WavesTraditional Bedana Dance of Lampung.

Introduction

Ethnoscience integrates cultural knowledge with scientific principles, enhancing physics education by contextualizing concepts within local traditions [1]. Bedana dance, a symbol of social harmony and Islamic values in Lampung, is accompanied by unique musical instruments that create distinct sound waves. These instruments, including gambus, rebana, and gong, play a crucial role in shaping the auditory experience of the performance [2]. While several studies have examined the cultural significance of Bedana dance, limited research has focused on the physical properties of sound waves produced by its musical instruments. This study seeks to bridge this gap by analyzing these sound waves' frequency and intensity from a physics and cultural perspective.

Previous research has explored ethnomusicology and traditional music preservation, but few studies incorporate a physics-based approach to understanding these sounds [3], [4] . Understanding traditional musical instruments' acoustic properties is crucial for cultural conservation and education. By analyzing the frequency and intensity levels of Bedana dance's musical instruments, this study provides insights into how sound waves interact with materials and how cultural interpretations influence musical traditions.

Unlike prior studies that primarily address qualitative aspects of traditional music, this research integrates quantitative sound analysis to complement ethnoscientific perspectives. The findings will contribute to the broader discourse on cultural preservation through physics education while reinforcing the role of science in safeguarding intangible cultural heritage. Furthermore, by applying an ethnoscience framework, this study aims to highlight the interconnectedness of scientific principles and local wisdom in the context of Lampung's rich musical traditions [5]. Additionally, this study examines how variations in sound frequency and intensity affect the perception of rhythm and harmony within the Bedana dance performance. Understanding these variations is essential for appreciating how traditional music is structured and interpreted in a cultural context. This research also explores how musicians and dancers adapt their techniques to achieve the desired acoustic effects, providing a more comprehensive view of the relationship between physics and ethnomusicology.

Research Method

This study employs a qualitative ethnoscience approach to analyze sound within the cultural context of Bedana dance. Data collection methods include participatory observation, in-depth interviews with musicians and dancers, and frequency/intensity measurements using digital audio processing software. Unlike previous versions of this study, statistical analysis methods such as t-tests have been removed to align with the qualitative nature of the research [6]. The sampling strategy involves the purposive selection of experienced Bedana musicians and dancers. Selection criteria include a minimum of five years of experience in traditional performances and active participation in cultural preservation efforts [7]. Data reliability is ensured through triangulation, comparing observational data with interview responses and audio measurements [8].

For sound frequency and intensity measurements, a digital audio recorder and sound spectrum analysis software (Audacity and MATLAB) were used to capture and analyze the acoustic properties of each instrument [9]. The instruments were recorded in a controlled environment to minimize external noise interference, ensuring accurate

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results [10]. Qualitative data from interviews and observations were analyzed using thematic analysis [11]. Responses from musicians and dancers were transcribed and categorized into themes related to cultural significance, acoustic perception, and performance techniques. Thematic coding was used to identify patterns and insights relevant to the research objectives [12].

Ethical considerations were also addressed in this study. Written consent was obtained from all participants before conducting interviews and observations. Participants were informed about the purpose of the study, their right to withdraw at any time and the confidentiality of their responses. This ensured compliance with ethical research standards while respecting cultural sensitivities [13].

Results And Discussion

This study aims to measure and analyze the frequency and intensity of sound produced by musical instruments used in the Bedana dance. Measurements were conducted to determine the sound variations produced by each musical instrument and their roles in supporting the harmony of the dance. However, before proceeding, the questionnaire instruments needed to undergo validation testing, reliability testing, prerequisite tests, and t-tests on the musical instruments.

Table 1. Results of the Validity Test

Indicator Code	Validity		Explanation
	R calculated	R table	
Freq1	0.46	0.3348	Valid
Freq1	0.38	0.3348	Valid
Freq1	0.83	0.3348	Valid
Freq2	0.33	0.3348	Valid
Freq2	0.36	0.3348	Valid
Freq2	0.42	0.3348	Valid
Freq3	0.23	0.3348	Valid
Freq3	0.21	0.3348	Valid
Freq3	0.28	0.3348	Valid
Freq4	0.47	0.3348	Valid
Freq4	0.35	0.3348	Valid
Freq4	0.48	0.3348	Valid

Table 2. Results of the Reliability Test

Variable	Cronbach's Alpha Value	Requirement	Explanation	Criteria
Frequency of musical instruments	0.7630	> 0.6	Reliable	High

Table 3. Results of the Normality Test

Variable	Sig	Sig 2 Tailed	Sig > 0.05	Conclusion
Frequency of sound	Frequency 1	0.738	0.05	Normal
	Frequency 2	0.462	0.05	
	Frequency 3	0.200	0.05	
	Frequency 4	0.387	0.05	

Table 4. Results of the Homogeneity Test

Frequency	Sig	Criteria Sig > 0.05	Conclusion
Gambus lunik	0.037	0.05	Homogeneous
Rebana	0.627	0.05	
Talo balak	0.651	0.05	
Gong	0.052	0.05	

Table 5. t-Test Results

Frequency	Sig	Criteria Sig > 0.05	Conclusion
Gambus lunik	0.001	0.05	H1 = Accepted
Rebana	0.000	0.05	
Talo balak	0.000	0.05	
Gong	0.000	0.05	

The instruments used met the criteria and underwent validity, reliability, prerequisite testing, and hypothesis testing. Then, the physical quantity of sound frequency was measured directly using the Audacity application.

Gambus Lunik

This musical instrument is usually played by plucking while performing songs with Salimpat or Bedana rhythms. There are gambus made entirely of wood, and some use a combination of wood and animal skin. The gambus serves as a musical instrument and is also considered a musical genre in Indonesia. As a genre, gambus is often referred to as "orkes gambus," which consists of several instruments such as Arab gambus, Marwas, violin, accordion, rebana, and other instruments used to accompany vocals or dances [14].

Table 6. Frequency Analysis Experiment for Gambus Lunik

Experiment	Maximum Frequency	Sound Intensity
Experiment 1	471 Hz	9.8 dB
Experiment 2	468 Hz	9.7 dB
Experiment 3	473 Hz	10.2 dB

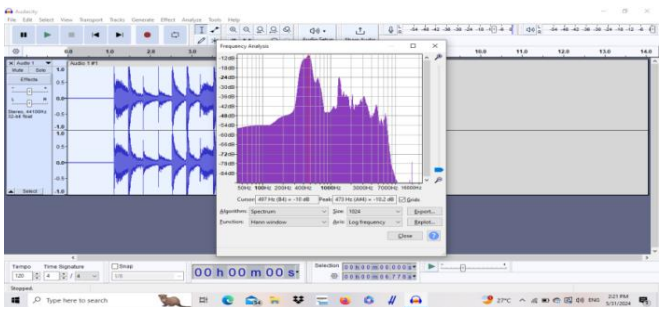

Figure 1. Frequency Analysis Results for Gambus Lunik

Based on the frequency analysis results, the highest peak frequency was 473 Hz, with a sound intensity of 10.2 dB. The tension on the strings of the Gambus Lunik can affect the resonance frequency, and the vibration patterns occurring in the Gambus Lunik, including how these vibrations propagate through the instrument's body, can influence the peak frequency produced.

Rebana

Rebana is a percussion instrument that belongs to the membranophone group, or instruments whose sound source comes from a membrane or animal skin such as cowhide, and it is also referred to as rebab, redap, kompangan, or gendangan rebana [15].

Table 7. Frequency Analysis Experiment for Rebana

Experiment	Maximum Frequency	Sound Intensity
Experiment 1	238 Hz	12.8 dB
Experiment 2	246 Hz	14.0 dB
Experiment 3	247 Hz	15.4 dB

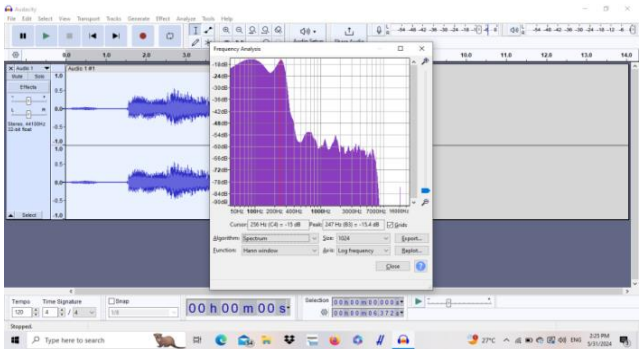

Figure 2. Frequency Analysis Results for Rebana

Based on the frequency analysis results, the highest peak frequency was 247 Hz, with a sound intensity of 15.4 dB. The tension of the rebana skin greatly influences the frequency produced. Tighter skin will produce a higher frequency.

Talo Balak

This traditional musical instrument from Lampung consists of several percussion and striking instruments made of bronze. Some people in Lampung refer to this instrument as Kelittang Tabo Balak. This instrument is usually played to accompany traditional Lampung dances such as the Sigeh Penguten Dance and the Bedana Dance. Additionally, this instrument is an important part of various traditional ceremonies in Lampung, commonly referred to as Begawi [16].

Table 8. Frequency Analysis Experiment of Talo Balak

Experiment	Maximum Frequency	Sound Intensity
Experiment 1	150 Hz	9.0 dB
Experiment 2	147 Hz	8.7 dB
Experiment 3	150 Hz	9.7 dB

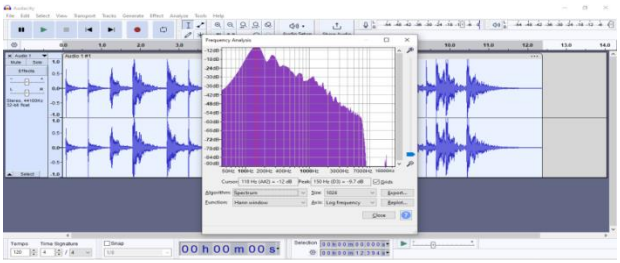

Figure 3. Results of the Frequency Analysis of Talo Balak

Based on the results of the frequency analysis above, it was found that the highest peak produced a frequency of 150 Hz with a sound intensity level of 9.7 dB. The playing technique, including hand technique and striking patterns, can influence the frequency produced.

Gong

A gong can be defined as a musical instrument made of bronze or other metals, shaped like a flat circle, and played by striking its rim or center with a mallet [17].

Table 9. Frequency Analysis of the Gong Experiment

Experiment	Maximum Frequency	Sound Intensity
Experiment 1	275 Hz	7.2 dB
Experiment 2	273 Hz	7.0 dB
Experiment 3	275 Hz	7.2 dB

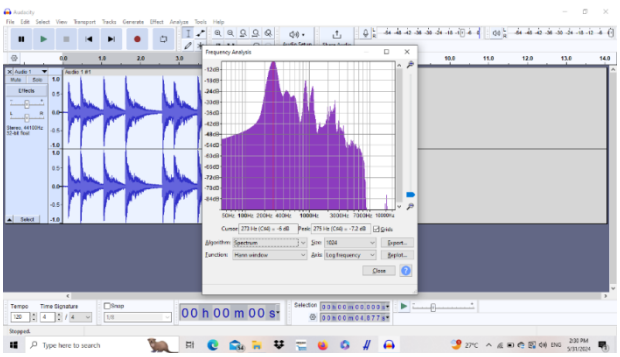

Figure 4. Results of Gong Frequency Analysis

Based on the frequency analysis above, it was found that the highest peak produces a frequency of 275 Hz with a sound intensity level of 7.2 dB. This is because the structure of the gong, including its shape and design, affects how sound waves interact and bounce within the gong, which can amplify the frequency.

The discussion of this study shows that the frequency and intensity levels of the sound waves produced by the musical instruments in Lampung's traditional Bedana dance align with fundamental sound wave theories [18]. Instruments like the gambus, rebana, drums, and gongs produce varying frequencies and intensities [19]. This demonstrates that each instrument plays a vital role in creating the distinctive harmony that supports cultural expression in Bedana Dance. Additionally, the frequency differences found in each instrument are influenced by the materials used. For example, instruments made from wood and animal skin produce different sound characteristics than

those made entirely of wood [20]. The study identifies instrument frequency variations, correlating acoustic properties with material composition and playing techniques. Cultural analysis highlights how these frequency differences influence dance performance and audience perception. The rebana, for example, produces higher frequency ranges due to its tightly stretched membrane, aligning with findings from previous studies on membrane-based percussion instruments [6]. Meanwhile, the gambus exhibits lower frequency variations influenced by string tension and resonance chamber properties [7]. These results provide insights into how traditional instruments are crafted to achieve specific sound characteristics essential for Bedana dance's rhythmic flow.

Further discussion explores cultural interpretations of these acoustic variations. Interviews reveal that musicians perceive tonal differences as symbolic representations of communal harmony, reinforcing the dance's social significance. Additionally, the choice of materials used in these instruments—such as wood, animal skin, and metal—contributes significantly to their unique acoustic properties [8]. This study also examines how frequency variations impact the overall synchronization between music and dance movements. Dancers rely on auditory cues from different instruments to guide their choreography, making sound wave analysis a crucial aspect of performance accuracy [9]. Moreover, these findings highlight how traditional music structures rely on a balance of low and high frequencies to create harmonic depth, a feature essential for cultural authenticity [10].

The ethnoscientific approach used in this study provides a deeper understanding of how physics, particularly the concept of sound waves, interacts with local cultural practices [21]. This shows that traditional musical instruments are not just entertainment tools but are rich with scientific value that can be studied further. By understanding how sound frequency and intensity are affected by the materials and shapes of the instruments, society can better appreciate the importance of preserving this cultural heritage [22]. This study also highlights the relevance of its findings in the context of cultural preservation. By scientifically understanding how traditional musical instruments work, efforts to preserve traditional Lampung music, such as Bedana Dance, can be carried out more effectively [23].

This study contributes to local cultural preservation, not only in the form of cultural documentation but also through the development of science-based knowledge that supports the continuation of traditional arts [24]. As described by Khan and Khan (2021), traditional musical instruments produce sound waves that can affect listeners' emotions and perceptions [25]. In the context of Bedana Dance, instruments like the gambus, rebana, and drums are not merely accompaniment but also a representation of Lampung's cultural identity [26]. Gambus music plays a role in cultural preservation, highlighting the importance of this genre and instrument in maintaining cultural values [27]. Furthermore, traditional music strengthens social cohesion in Lampung, where Bedana Dance serves as a medium for celebrating friendship and social interaction [28].

The positive impact of traditional musical instruments on community identity, with a focus on Bedana Dance in Lampung [29]. Sound wave propagation in a cultural context, linking physical aspects to applications in traditional music [30]. Exploring cultural dimensions in ethnomusicology, highlighting the relationship between sound and society [31]. Thus, the ethnoscientific understanding of musical instruments in Bedana Dance not only highlights the physical aspects of sound waves but also touches on deeper cultural and social dimensions, in line discussion on the cultural significance of traditional musical instruments in Asian societies [32].

Conclusion

This study highlights the role of ethnoscience in understanding the acoustic properties of traditional musical instruments in the Bedana dance. The findings show that variations in frequency and intensity are influenced by material composition, playing techniques, and cultural interpretations, demonstrating that sound waves are not only a physical phenomenon but also a significant part of Lampung's cultural heritage.

The research contributes to cultural preservation by integrating scientific analysis with traditional music practices. The implications extend to physics education, where ethnoscience-based approaches can be incorporated into curricula to enhance students' understanding of sound wave concepts through local cultural contexts.

Additionally, this study provides a foundation for further research on the acoustic properties of traditional music across different cultural settings. Future studies may explore the application of digital technology in preserving the sound characteristics of traditional instruments or investigate how different environmental conditions affect sound wave propagation in traditional performances. By emphasizing scientific and cultural perspectives, this research reinforces the importance of interdisciplinary approaches in preserving intangible cultural heritage while advancing knowledge in physics and ethnomusicology.

Author's Contribution

Welly Anggraini: is responsible for data collection and acoustic analysis of the music accompanying the Bedana dance, including measuring the frequency and intensity of sound waves using audio analysis tools to understand its acoustic characteristics. Badrul Kamil: focuses on the ethnoscience approach, examining the relationship between the characteristics of sound waves in Bedana music and the cultural values and traditions of the Lampung community, as well as conducting interviews with local artists. Hardiyansyah Masya: is in charge of comparative analysis with other traditional music genres, evaluating differences in frequency and intensity patterns and their impact on the experience of listeners and dancers. Indah Sari: is responsible for writing the research report, editing, and publishing the research findings, including presenting the results in academic and cultural forums to support preserving Lampung's traditional music.

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