

***Om-kara* As an Integrated Ethnoscience Through Ethnocosmology, Ethnoanatomy and Ethnobiaoustics**

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Abstract

The sacred script of *Om-kara* in Balinese Hindu culture represents a traditional knowledge system encompassing cosmology, anatomy, and bioacoustics. This study analyzes *Om-kara* through an integrated ethnoscience perspective, connecting Balinese philosophical teachings with contemporary scientific knowledge. Employing qualitative library research, the study applies hermeneutic analysis to *Siwa Tattwa*, *Kadyatmikan*, *Mantra*, and *Usada* manuscripts, supported by literature on neuroscience, bioacoustics, and medical physiology. The findings reveal three interconnected dimensions. First, ethnocosmologically, *Nada* and *Windu* within *Ulu Candra* symbolize cosmic creation (*Utpatti*), from *Niskala* to *Prakreti*. Second, ethnoanatomically, sacred syllable placement (*nyasa*) establishes symbolic correspondences between *Windu* at *selaning lalata* (*Ajña cakra*) and scientific discussions of pineal anatomy, melatonin regulation, and alpha brainwave activity (8-12 Hz). Third, ethnobiaoustically, *Pranawa* chanting provides conceptual connections to autonomic regulation, vagal activity, and amygdala deactivation. Related studies report increased high-frequency heart rate variability from 1294.9 to 2295.9 ($p < .001$), although these physiological associations require further empirical validation. This study contributes to ethnoscience by proposing an interdisciplinary framework that integrates Balinese indigenous knowledge with contemporary scientific concepts. Its practical implications for educational science include developing culturally responsive teaching materials, integrating local wisdom into Hindu religious and science curricula, and promoting scientific literacy, critical thinking, and cultural awareness. Thus, *Om-kara* provides a conceptual foundation for ethnoscience-based education and future interdisciplinary research.

Keywords: *Om-kara*; Ethnoscience; *Siwa Tattwa*; Pineal Gland; Vagus Nerve

Introduction

The sacred script *Om-kara* (*Ongkara*) constitutes an essential element of Balinese Hindu cultural and spiritual heritage, representing not only the divine (*Ida Sang Hyang Widhi Wasa*) but also a traditional knowledge system encompassing cosmology, human embodiment, and sacred sound. Within the *Siwa Tattwa* tradition, particularly the *Bhuwana Kośa*, *Wrhaspati Tattwa*, *Jñanasiddhanta*, and *Catur Pranawa*, *Om-kara* symbolizes the relationship between the macrocosm (*Bhuwana Agung*) and microcosm (*Bhuwana Alit*) through the interconnected principles of creation, consciousness, and bodily existence (Yasa, Gitananda and Putra, 2023). However, contemporary interpretations frequently emphasize its ritual and theological significance while paying limited attention to its potential as a culturally embedded knowledge system. This situation highlights the need for an interdisciplinary approach that examines *Om-kara* through ethnoscience without reducing its spiritual meanings to purely physiological explanations.

Previous studies have explored *Om-kara* from various disciplinary perspectives. Rema, Sudiana and Suarka (2024) investigated its historical development through Old Balinese inscriptions, while Giri and Windya (2024) examined *Yogākṣara* within *Śīwa Tattwa* as a spiritual discipline associated with *kalepasan* (liberation). Dewi (2021) interpreted *Oṅkara Pranava* as an embodied ritual concept, whereas Yasa (2017, 2020) and Yasa et al., (2023) elaborated its philosophical and textual significance within Balinese Śaiva traditions. Heriyanti and Dewi (2021) further discussed the relationship between yoga practices, mental balance, and physical well-being. Collectively, these studies establish the historical, philosophical, and cultural foundations of *Om-kara*, but provide limited interdisciplinary analysis connecting its symbolic structures with contemporary scientific concepts.

Meanwhile, biomedical research has examined the physiological and neurological correlates of Om chanting. Kalyani et al., (2011) reported changes in limbic brain activity during Om chanting using functional magnetic resonance imaging, while Inbaraj et al., (2022) identified changes in heart rate variability associated with autonomic regulation. Clinical studies have also reported improvements in selected cardiovascular and psychological outcomes following Om-related interventions, including combinations with yoga nidra and listening to recorded chanting (Anjana, Archana and Mukkadan, 2022; Bhoot, Chowdhury, Shah and Vaishnav, 2025). Furthermore, Hotho, Von Bonin, Krüerke, Wolf and Cysarz (2022) investigated cardiovascular oscillations during rhythmic chanting, while Saini et al., (2024) and Tayade et al., (2024) examined changes in cortical activity and electroencephalographic patterns. Related reviews have discussed the potential applications of *mantra* chanting for psychophysiological well-being (Bongarge, Jadhav and Godbole, 2022; Jose, Pushpanathan, Kumaran, Mukkadan and Natarajan, 2025). Nevertheless, these findings arise from different experimental conditions and populations and do not directly establish the physiological effects of Balinese *Om-kara* practices.

Despite these contributions, existing scholarship remains largely divided between textual-philosophical interpretations and biomedical investigations. In particular, limited attention has been given to systematically integrating the cosmological symbolism, embodied arrangement of sacred syllables (*nyasa*), and acoustic dimensions of *Pranawa* within a unified ethnoscience framework. This gap is significant because the relationship between traditional knowledge and modern science requires careful interpretation that distinguishes symbolic correspondences from empirically demonstrated physiological mechanisms. Addressing this gap also has educational relevance, as an integrated interpretation of *Om-kara* may provide culturally meaningful resources for developing ethnoscience-based learning materials, contextual science education, and Hindu religious education.

Accordingly, this study proposes an interdisciplinary ethnoscience framework comprising three interconnected dimensions: ethnocosmology, which examines the symbolic stages of cosmic creation (*Utpatti*) through *Nada*, *Windu*, and *Ardhacandra*; ethnoanatomy, which interprets the placement of sacred syllables (*nyasa*) in relation to traditional understandings of the human body and contemporary anatomical concepts; and ethnobioacoustics, which explores conceptual relationships between *Pranawa* chanting and scientific research on neural and autonomic responses. The novelty of this study lies in integrating these three dimensions into a coherent interpretive framework grounded in Balinese sacred texts while critically engaging with contemporary scientific literature. Beyond its theoretical contribution, this framework offers potential applications for culturally responsive education, the preservation of indigenous knowledge, and the development of interdisciplinary research.

Based on this research gap, the study addresses two questions: (1) How do the *Siwa Tattwa* and related Balinese lontar texts conceptualize *Om-kara* through the interconnected dimensions of ethnocosmology, ethnoanatomy, and ethnobioacoustics? (2) How can these traditional concepts be critically interpreted alongside contemporary neuroscientific and physiological findings within an integrated ethnoscience framework? To address these questions, the study employs qualitative library research using intertextual hermeneutics and *Tattwa* semiotic analysis. Primary sources include the *Siwa Tattwa*, *Kadyatmikan*, *Mantra*, and *Usada* manuscripts, while secondary sources comprise relevant research in neuroscience, bioacoustics, and medical physiology. Through this approach, the study seeks to advance the theoretical development of ethnoscience and provide a conceptual foundation for integrating Balinese indigenous knowledge into interdisciplinary education and future empirical investigations.

Method

This study employed a descriptive-interpretive qualitative library research approach integrating intertextual hermeneutics, *Tattwa* semiotics, and an interdisciplinary ethnoscience framework. Primary data were drawn from Balinese lontar manuscripts, including *Siwa Tattwa*, *Kadyatmikan*, *Mantra*, and *Usada*, with textual interpretation supported by (Yasa, 2020; Soebadio, 1985; Zoetmulder, 1982). Secondary data comprised scholarly publications on neuroscience, bioacoustics, and medical physiology. Data analysis followed three sequential stages. First, data reduction involved identifying, selecting, and categorizing relevant textual passages and scientific findings according to ethnocosmology, ethnoanatomy, and ethnobioacoustics. Second, data display organized these categories into comparative matrices linking traditional concepts, symbolic meanings, and corresponding scientific findings to facilitate interdisciplinary conceptual triangulation. Third, conclusion drawing and verification involved interpreting the relationships through intertextual hermeneutics, cross-checking textual sources, and assessing the consistency of conceptual correspondences with published scientific evidence. This triangulation was interpretive rather than experimental and did not establish direct physiological causality between *Om-kara* practices and biomedical outcomes.

Results and Discussion

1. Ethnocosmology: *Om-kara* As A Symbolic Framework Of Cosmic Creation And Ethnoscience Education

Within Balinese Hindu philosophy, *Om-kara* represents an integrated relationship between cosmic consciousness (*Purusa/Cetana*) and material existence (*Prakreti/Acetana*). Its visual structure comprises *Ulu Candra*, associated with the transcendent dimension, and *Wiswa/Okara*, associated with manifested existence. The interaction of these components reflects the relationship between the macrocosm (*Bhuwana Agung*) and microcosm (*Bhuwana Alit*). As explained in the *Bhuwana Kośa* and related *Siwa Tattwa* traditions, creation (*Utpatti*) is understood as a progressive manifestation from subtle consciousness toward material existence (Yasa et al., 2023).

The cosmological sequence is represented through *Niskala*, *Nada*, *Windu*, *Ardhacandra*, and *Wiswa/Okara*. *Niskala* signifies transcendent, unmanifest reality; *Nada* represents the primordial principle of sound or vibration; *Windu* symbolizes the concentrated potential of manifestation; *Ardhacandra* represents an intermediate stage of differentiation; and *Wiswa/Okara* signifies the manifested universe. The *Bhuwana Kośa* presents these elements within a theological and metaphysical explanation of creation rather than an experimentally established account of physical cosmogenesis. The textual

interpretation developed by Yasa et al., (2023) provides an important foundation for understanding these concepts within the Balinese tradition of mystical knowledge and priestly yoga.

This interpretation also encompasses the reverse process of dissolution (*Pralina*) and spiritual liberation (*kalepasan*), in which differentiated existence returns toward its transcendent source. The complementary processes of *Utpatti* and *Pralina* demonstrate the cyclical character of Balinese cosmological thought. Yasa (2020) further explains the significance of sacred syllables as symbolic and contemplative instruments within Balinese script-based spiritual disciplines. These textual traditions reveal that *Om-kara* functions as more than a visual religious symbol: it provides an internally structured model through which relationships among consciousness, existence, and spiritual transformation can be understood.

From an ethnoscience perspective, the educational significance of this cosmological model lies in its potential to introduce students to different systems of knowledge and explanation. The progression from *Niskala* to *Wiswa* can be examined as a traditional symbolic model of cosmic manifestation and compared with the methods used in contemporary scientific cosmology. However, such comparison must distinguish philosophical analogy from empirical equivalence. For example, *Nada* should not be presented as scientifically identical to an acoustic wave preceding the formation of the physical universe, nor should *Windu* be equated directly with a physical particle or a cosmological singularity. Instead, these concepts can support discussions of how cultural traditions construct explanations of origins, transformation, and the relationship between humanity and the universe.

In educational practice, the *Om-kara* cosmological sequence can be developed into visual learning materials, comparative conceptual diagrams, and interdisciplinary discussions connecting Hindu philosophy, cultural history, and scientific reasoning. Students may analyze the symbolic meaning of each component, identify differences between metaphysical and scientific explanations, and evaluate the evidence required to support particular claims. This approach positions Balinese local wisdom as a legitimate subject of scholarly inquiry while strengthening cultural literacy and critical thinking.

2. Ethnoanatomy: Sacred Syllable Placement, Embodied Knowledge, And Scientific Literacy

The ethnoanatomical dimension of *Om-kara* is grounded in the Balinese Hindu understanding of the human body as *Bhuwana Alit*, a microcosmic reflection of *Bhuwana Agung*. In the *Catur Pranawa*, *Jñanasiddhanta*, and related script traditions, sacred syllables are associated with particular bodily locations through *nyasa*, a contemplative practice involving the placement or visualization of sacred sounds and symbols. The textual mapping identifies the lungs with *Okara*, the spleen with *Ardhacandra*, the liver with *Windu*, the gallbladder with *Nada*, and the heart with *Matra* (Soebadio, 1985). These correspondences express the ritual and symbolic organization of the body rather than anatomical classifications derived from modern dissection or physiological measurement.

The *Bhuwana Kośa* also associates different bodily regions with sacred realms, divine manifestations, and syllabic formulas. Such arrangements establish a relationship between bodily awareness, spiritual concentration, and cosmological order. In *Wijākṣara: Tuntunan Yoga Anak Nyastra Bali*, Yasa (2020) discusses sacred-script practices and the role of *wijākṣara* as both ritual instruments and *mantra* formulations. These teachings provide an important cultural context for understanding *nyasa* as an embodied form of knowledge transmission. Particular attention is given to *Windu*, which is associated in some contemplative interpretations with *selaning lalata*, the region between the

eyebrows, and the *Ajña cakra*. The pineal gland, by contrast, is an endocrine structure situated deep within the brain and involved in melatonin secretion and circadian regulation. Although the symbolic location of *Windu* may be compared with contemporary discussions of cranial anatomy and meditative attention, this correspondence does not demonstrate that the traditional point identifies the pineal gland anatomically or directly regulates its hormonal activity.

Recent neurophysiological research offers a more appropriate basis for exploring the relationship between contemplative practices and brain activity. Kanwade et al., (2025), in an electroencephalography study of responses to OM chanting, reported a 34.2% increase in alpha amplitude and an 85.4% improvement in the theta/beta ratio. These findings suggest changes in neural activity associated with relaxation and attention under the conditions examined. Nevertheless, they do not establish that concentration on *Windu* specifically stimulates the pineal gland or increases melatonin secretion. Similarly, observations of brainwave changes during chanting should not be interpreted as evidence that traditional *nyasa* locations correspond to discrete neural structures. The educational contribution of this analysis is the development of a comparative approach to traditional and scientific understandings of the human body. Students can examine *nyasa* as a cultural model of embodied spirituality while studying anatomical structures, endocrine functions, and electroencephalographic activity through scientific sources. A learning activity might involve comparing a traditional *Om-kara* body map with a modern anatomical diagram and classifying the relationships as symbolic, anatomical, functional, or empirically unverified.

Such activities can strengthen scientific literacy by teaching students to distinguish cultural interpretation from measurable physiological evidence. They also encourage respect for indigenous knowledge without requiring traditional concepts to be treated as literal scientific descriptions. In this way, *Om-kara* ethnoanatomy provides a foundation for culturally responsive learning that connects Hindu religious education with biology, human physiology, and the philosophy of science.

3. Ethnobiocoustics: *Pranawa* Chanting, Neurophysiological Findings, and Contextual Learning

The ethnobiocoustic dimension concerns the relationship between the sacred phonation of *Pranawa* (A-U-M), respiratory activity, bodily vibration, and neurophysiological responses. In Balinese Hindu practice, the recitation of *Om-kara* is embedded within spiritual disciplines involving breath regulation, concentration, and sacred sound. The *Bhuwana Kośa* discusses the relationship between breath, *Ātmā*, and *Śiwa* within yogic practice, while Yasa (2020) situates sacred syllables within the broader tradition of Balinese *mantra* and script-based spiritual exercises. From an acoustic perspective, chanting involves coordinated activity of the respiratory system, vocal folds, oral cavity, and nasal resonators. The production of A-U-M changes the configuration of the vocal tract and may generate different patterns of audible sound and perceived vibration. Chaswal (2025) discusses these phonatory characteristics and their potential relationship to relaxation. However, a single frequency cannot be assumed to characterize all forms of OM chanting because vocal fundamental frequency, harmonic content, resonance, and breathing patterns vary among individuals and practices.

Neuroimaging findings provide a basis for examining possible physiological associations. Kalyani et al., (2011) reported reduced activity in several limbic and related brain regions during audible OM chanting, including the amygdala, hippocampus, insula, and anterior cingulate cortex. These observations were discussed in relation to patterns reported in vagus nerve stimulation research. Nevertheless, similarity in neuroimaging

responses does not establish that chanting produces the same neural mechanisms or therapeutic effects as clinically administered vagus nerve stimulation. Autonomic findings provide further evidence of physiological responses associated with chanting. Research on OM chanting has examined heart rate variability (HRV), which provides indirect information about cardiac autonomic regulation. Inbaraj et al., (2022) reported an increase in high-frequency HRV power among experienced yoga practitioners following a brief period of OM chanting, with reported values increasing from 1294.9 to 2295.9 ($p < .001$). This finding is consistent with an acute change in cardiac vagal modulation under the study conditions, although HRV measures must be interpreted in relation to respiration and other physiological influences.

Additional clinical evidence is provided by Bhoot et al., (2025) who conducted a randomized controlled trial involving 60 patients with stage 1 hypertension. Participants in the intervention group listened to a specially prepared 528 Hz OM chanting recording for 15 minutes daily over one month, alongside standard care. The researchers reported improvements in selected cardiovascular, HRV, psychological well-being, and sleep-related outcomes. Importantly, this intervention involved listening to recorded chanting rather than performing Balinese *Om-kara* vocalization. The findings therefore support further investigation of sound-based interventions but cannot be directly generalized to all forms of *Pranawa* practice. Research on cortical activity also contributes to this discussion. Kanwade et al., (2025) reported changes in alpha activity and the theta/beta ratio, while related electroencephalographic studies have investigated changes in cortical activity and EEG microstates associated with chanting (Saini et al., 2024; Tayade et al., 2024). Together, these studies indicate that OM-related interventions can be associated with measurable neurophysiological changes, although differences in experimental design, participant characteristics, and intervention procedures limit direct comparison.

Neurochemical explanations require greater caution. Jose et al., (2025) in a narrative review addressing OM chanting and Type D personality, discussed possible relationships among autonomic regulation, stress physiology, and psychological well-being. Other reviews have proposed roles for GABAergic and serotonergic pathways (Kumar et al., 2025). However, these discussions should be distinguished from direct experimental demonstrations that Balinese *Om-kara* chanting increases GABA, serotonin, or melatonin concentrations. The available literature reviewed here does not establish a verified causal sequence from *Pranawa* phonation through vagal activation to specific neurochemical changes in Balinese practitioners.

Within ethnoscience education, these findings can support interdisciplinary learning that connects traditional chanting practices with acoustics, respiratory physiology, neuroscience, and research methodology. Students may examine how sound is generated, compare acoustic frequency with brainwave frequency, interpret basic HRV or EEG findings, and evaluate differences between experimental studies and narrative reviews. Such learning activities can also clarify that a 528 Hz recorded audio intervention, a vocal fundamental frequency, and an 8-12 Hz alpha brainwave are different physical or physiological measurements and should not be treated as interchangeable. Consequently, the educational value of ethnobioacoustics extends beyond presenting the potential benefits of chanting. It offers opportunities for evidence-based inquiry, critical evaluation of health claims, and culturally responsive scientific learning. Traditional *Pranawa* practice provides the cultural context, while contemporary scientific studies supply methods for investigating selected physiological phenomena. Their integration is therefore pedagogical and interpretive rather than proof of direct biomedical equivalence.

4. Epistemological Considerations, Research Limitations, and Implications for Ethnoscience Education

The integration of Balinese lontar texts with contemporary neuroscience requires recognition of the different epistemological foundations of traditional and scientific knowledge. The *Bhuwana Kośa* articulates spiritual, cosmological, and contemplative meanings within a Hindu philosophical framework. Neuroscientific studies, by contrast, investigate observable and measurable responses using methods such as functional magnetic resonance imaging, electroencephalography, and heart rate variability analysis. These knowledge systems can be placed in dialogue, but their concepts and methods should not be regarded as automatically equivalent. This epistemological distinction is reflected in *Bhuwana Kośa*, Patalah IX.12, which emphasizes the importance of *niṣkala jñāna*, or spiritual knowledge that transcends ordinary sensory understanding:

Jñāna twan niṣkalan dewi, rahasyam mama durllabham.

Translation:

This nonmaterial spiritual knowledge, O Goddess, is my profound and exceedingly difficult-to-attain secret (Yasa et al., 2023).

The passage establishes spiritual knowledge as a profound form of understanding pursued through contemplation and disciplined interpretation. From an ethnoscience perspective, it illustrates that the epistemological foundations of Balinese Hindu knowledge differ from those of modern empirical science. While *niṣkala jñāna* concerns spiritual realization and transcendent understanding, neuroscience investigates measurable physiological processes. Therefore, the relationship between traditional knowledge and scientific findings should be developed through critical interpretation rather than claims of direct equivalence. In educational contexts, this distinction provides a foundation for teaching students to appreciate indigenous knowledge while critically examining the methods, evidence, and limitations associated with scientific explanations. The present study therefore identifies three levels of interdisciplinary relationship. The first is symbolic correspondence, in which traditional concepts and scientific phenomena share interpretive similarities without demonstrating physical identity. The second is functional analogy, in which traditional practices and experimentally studied interventions may involve comparable activities, such as breath regulation, vocalization, or sustained attention. The third is empirical association, in which published studies document measurable outcomes under specified experimental conditions. Distinguishing these levels prevents conceptual comparisons from being presented as causal evidence.

Several limitations must be acknowledged. First, this research is based on textual interpretation and secondary scientific literature rather than direct measurements of Balinese *Om-kara* practitioners. Second, the biomedical studies reviewed involve heterogeneous interventions, including active chanting, recorded audio, meditation, and combined yogic practices. Third, the proposed correspondences between *Windu* and the pineal gland, or between *Pranawa* and particular neurotransmitter pathways, remain hypotheses or interpretive analogies rather than experimentally validated mechanisms. Fourth, the interpretation of Kawi and Sanskrit-derived terms may vary across manuscript traditions and scholarly translations. Despite these limitations, the study offers a conceptual contribution to ethnoscience education by demonstrating how indigenous knowledge can be incorporated into interdisciplinary inquiry without compromising scientific standards. The three-dimensional framework of ethnocosmology, ethnoanatomy, and ethnobioacoustics provides a basis for developing contextual teaching materials, comparative learning activities, and research-based discussions in Hindu religious education and science education.

Future educational research could develop and evaluate instructional modules based on this framework, examining their effects on students' understanding of Balinese cultural knowledge, scientific literacy, critical thinking, and ability to distinguish symbolic interpretation from empirical evidence. Future biomedical research could separately investigate the acoustic characteristics, respiratory patterns, HRV responses, and neural correlates of Balinese *Om-kara* practices using clearly defined protocols. Accordingly, the principal contribution of this study is not the clinical validation of traditional sacred-script practices but the formulation of an interdisciplinary ethnoscience model that connects Balinese philosophical heritage with contemporary scientific inquiry. This model offers a culturally grounded approach to education in which local wisdom becomes a source of meaningful questions, comparative interpretation, and scientifically responsible investigation.

Conclusion

This study concludes that *Om-kara* represents an integrated system of Balinese traditional knowledge encompassing three interconnected ethnoscientific dimensions: ethnocosmology, ethnoanatomy, and ethnobioacoustics. Through hermeneutic interpretation of *Siwa Tattwa* lontar texts and conceptual comparison with contemporary neuroscience, the study identifies symbolic correspondences and functional analogies between sacred-script philosophy, representations of the human body, and physiological processes associated with chanting and meditation. These relationships provide an interdisciplinary interpretive framework rather than empirical confirmation of anatomical equivalence or specific neurochemical mechanisms. Theoretically, the findings contribute to ethnoscience scholarship by establishing a culturally grounded framework for dialogue between Balinese Hindu philosophical knowledge and modern scientific inquiry. Practically, they offer a conceptual basis for developing contextual ethnoscience learning materials and exploring *Om-kara*-based contemplative practices as potential complementary approaches to well-being. At the institutional and policy levels, the findings support the integration of local wisdom into interdisciplinary curricula and research initiatives, particularly in Hindu higher education. Future studies should empirically examine Balinese *Om-kara* practices through standardized protocols and physiological measurements, while educational research should evaluate the effectiveness of the proposed ethnoscience framework in promoting cultural understanding, scientific literacy, and critical thinking.

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