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Research Article

Digital Ethnography of Nongnong Mbaham: Oral Literature Revitalization for Cultural Identity and Contextual Learning Innovation in Papuan Education

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Article Info

ABSTRACT

Purpose of the study: This study investigates Nongnong Mbaham as a living oral tradition, examines its transformation within digital environments, and explores its potential as a contextual learning innovation in Papuan educational settings.

Methodology: A qualitative digital ethnographic approach was employed, involving participant observation, in-depth interviews, performative analysis, and digital-trace analysis across offline and online cultural spaces.

Main Findings: This study demonstrates that indigenous oral literature can function as a culturally grounded learning resource that supports identity formation, digital literacy, and contextual pedagogy.

Novelty/Originality of this study: This research advances oral-literature studies by integrating digital ethnography with contextual learning innovation, moving beyond documentation toward a sustainable educational revitalization model.

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1. INTRODUCTION

Oral literature functions as a central epistemic domain through [1], which communities articulate cultural identity [2], preserve collective memory [3], and negotiate social values [4]. In many Indigenous societies of Indonesia, oral traditions operate not merely as aesthetic expressions but as pedagogical systems that transmit ethics [5], [6], cosmology [7], and social responsibilities across generations [8]. Among the Mbaham people of Papua, the *nongnong*, a traditional poetic-chanting form, holds a distinguished cultural position because it fuses genealogical narration, rhythmic-performative structure, and spiritual symbolism into a single communicative practice [9]. As a medium that conveys ancestral histories, clan relations, and moral guidance, *nongnong* constitutes a cultural mechanism for maintaining social cohesion and mediating interclan relations [10]. Its highly structured rhythms and formulaic patterns require stable intergenerational transmission, rendering

it particularly vulnerable as domains of Indigenous social life shrink and the younger generation becomes increasingly oriented toward modern media and urban lifestyles [11]. In the context of accelerating modernization and digital influence, *nongnong* is now situated at a critical juncture where traditional performance spaces diminish while digital cultural production expands rapidly [12].

Recent scholarship has increasingly emphasized the need to revitalize oral traditions through approaches adapted to digital ecosystems. Studies on cultural education argue that oral traditions lose their pedagogical power when disconnected from youths' learning contexts [13]. Research on digital dissemination of intangible heritage indicates that digital platforms can significantly broaden cultural reach, yet such processes must safeguard authenticity and cultural integrity [14], [15]. Investigations on contextual learning also demonstrate that embedding local culture into curricula enhances learning relevance and strengthens students' cultural identity [16]-[18]. Within this academic milieu, digital ethnography has emerged as a critical methodological approach that documents practices [19], [20], traces their digital transformation [21], and analyzes interactions between orality, literacy, and digitality [22], [23]. When applied to the *Nongnong Mbaham* tradition, this approach enables the development of culturally grounded learning innovations where oral performance, community knowledge, and digital media coalesce into pedagogical experiences relevant to contemporary learners.

However, existing studies on digitalized oral traditions predominantly emphasize documentation and preservation, with limited attention to how digital environments reconfigure performativity, cultural authority, and pedagogical integration within formal education [24]. Moreover, oral traditions are often positioned as supplementary cultural content rather than epistemological foundations for contextual learning. Educational research that incorporates local culture often treats tradition merely as illustrative content rather than as an epistemological foundation for learning. Consequently, a conceptual gap persists in understanding how highly performative oral traditions such as *nongnong*, which relies on voice modulation, bodily expression, clan-based authority, and spiritual narrative adapt in rapidly shifting digital spaces. Existing studies seldom interrogate how oral traditions are renegotiated, recontextualized, or even contested when circulated through digital platforms. Digital ethnography therefore provides an analytical vantage point for examining the reconfiguration of meaning, the redistribution of cultural authority, and the technological mediation of identity formation. In this regard, *Nongnong Mbaham* offers a distinct cultural landscape: its rhythmic structure, genealogical encoding, and ritual significance differ markedly from other Papuan oral traditions and demand a deeper, contextually grounded analysis.

This study aims to describe the forms, meanings, and sociocultural functions of *nongnong* within Mbaham society; to analyze its transformation within digital environments; and to develop a digital-ethnography–based revitalization model that can be adopted as contextual learning innovation in educational settings across Papua. The findings are expected to advance theoretical discussions on the transformation of oral traditions in digital contexts, especially regarding shifts in performativity, cultural authority, and intergenerational transmission. Practically, this research contributes to the development of culturally rooted curricula that position local traditions not as supplementary content but as central learning resources, and offers strategies for cultural revitalization that strengthen youth identity in the digital era. Through this approach, *nongnong* moves beyond mere documentation: it becomes a living, learnable, and teachable cultural practice capable of sustaining the Mbaham people's identity within both physical and digital worlds.

2. RESEARCH METHOD

This study adopts a qualitative approach using a digital-ethnographic method of oral literature. This approach is designed to capture cultural practices as they unfold across two interconnected domains: the traditional performative spaces in which *Nongnong Mbaham* has long been transmitted, and the contemporary digital environments where the tradition is increasingly mediated, reshaped, and reproduced. Digital ethnography enables the researcher to examine *nongnong* not simply as a verbal text, but as a culturally embedded performance involving rhythm, embodiment, genealogical narration, and social authority. It also facilitates an understanding of how the circulation of *nongnong* in digital platforms transforms patterns of participation, alters the role of the elder-performer, and influences how the younger generation reinterprets and engages with this cultural form. Through this design, the study aims to trace the movement of *nongnong* across offline and online contexts and interrogate the cultural negotiations that occur during this transition.

The research was conducted within the Mbaham community in Papua, where *nongnong* continues to function in ritual events, communal gatherings, and daily social practices. The study takes place in customary villages, community houses, and educational institutions located within the Mbaham cultural area, as well as within the digital platforms frequently accessed by community members, such as messaging groups, social-media pages, and video-sharing channels. Participants include traditional performers who safeguard genealogical knowledge, community elders who possess interpretive authority, teachers and students who engage with local cultural materials in classroom settings, and local cultural actors involved in community-based tourism or digital

content creation. Participants were selected purposively to ensure that the data reflect both the continuity of traditional knowledge and the emerging forms of interaction occurring in digital spaces.

The study draws on two main categories of data: primary and secondary sources. Primary data were generated through prolonged engagement with cultural performers, direct observation of live *nongnong* performances, and systematic observation of the digital presence of *nongnong* across online platforms. Interviews provide interpretive insights into the meanings, functions, and perceived transformations of the tradition, while field observations capture the performative and social dimensions of the chant as enacted in customary settings. Secondary data include archival recordings preserved within families, community documents, local histories, scholarly works on Papuan oral traditions, regional educational guidelines, and digital materials produced by community members that illustrate the ways *nongnong* is circulating and being reframed in contemporary contexts.

Data collection in this study was carried out through sustained immersion in both customary and digital environments, allowing the researcher to witness how *Nongnong Mbaham* operates within the everyday life of the community. In customary settings, the researcher participated in community events, evening gatherings, and ritual occasions where *nongnong* naturally emerges as a communicative practice. During these engagements, the researcher positioned themselves within the social flow of the event, observing how performers initiated the chant, how audiences responded, how interactional sequences unfolded, and how the cultural atmosphere surrounding the performance shaped its delivery. These encounters were not limited to formal performances but also occurred in informal, spontaneous situations that revealed the lived character of *nongnong* within the Mbaham worldview.

In-depth interactions with cultural elders, performers, teachers, and students were conducted throughout the fieldwork period. These interactions unfolded through repeated visits, informal conversations, and culturally appropriate dialogue practices that allowed participants to speak on their own terms. Rather than relying on a single interview moment, the researcher engaged in iterative discussions that gradually unveiled participants' perspectives on the cultural significance of *nongnong*, its transmission between generations, and their experiences with its presence—or absence—in contemporary life. This prolonged engagement provided contextual richness that cannot be achieved through structured questioning alone and allowed the researcher to understand how meaning is co-constructed in the field.

Digital data were collected through systematic engagement with the online environments where *nongnong* has begun to circulate. The researcher browsed through community-shared videos, social-media posts, and digital conversations across platforms used by the Mbaham community, observing how recordings were shared, how viewers interacted, and how the chants were reframed within the logic of digital platforms. This process included revisiting posts over time to observe the evolution of interactions, tracing how specific recordings spread within community networks, and paying attention to the informal discussions, humor, reinterpretations, or contestations that emerged around digital representations of *nongnong*. These engagements allowed the researcher to understand how digital spaces restructure cultural visibility and participation.

Fieldnotes were produced continuously throughout the data collection process, synthesizing observations, conversations, situational cues, and the researcher's interpretive reflections. These notes were crucial for capturing the temporal rhythm of the field, the atmospheres of performance, the subtleties of social relations, and the shifts occurring across offline and online settings. The combination of sustained physical presence, iterative interpersonal engagement, and long-range digital observation ensured that the data reflect not only what *Nongnong Mbaham* is as a cultural form, but how it moves, transforms, and acquires meaning within contemporary Mbaham life.

The instruments used in this study consist of a semi-structured interview guide, a performative observation sheet, and a digital-trace analysis protocol designed to capture the complexity of *Nongnong Mbaham* across both customary and digital environments. The interview guide was constructed around three thematic domains—cultural meanings, mechanisms of transmission, and perceptions of digital transformation. For traditional performers and cultural elders, the instrument includes prompts concerning the rhythmic structure of *nongnong*, the genealogical and moral values embedded within its narrative formulas, the role of senior performers in sustaining cultural authority, and their perspectives on the circulation of *nongnong* through digital platforms. For teachers and students, the guide explores their understanding of the relevance of *nongnong* in learning, their experiences engaging with local oral traditions, and their views on the integration of *nongnong* into context-based educational practices. Although flexible in application to accommodate field dynamics, the instrument maintains clear thematic orientation to ensure coherence and depth in the data generated.

The observation and digital-trace analysis instruments were employed to document the performative and media-transformative dimensions of *Nongnong Mbaham*. The performative observation sheet captures descriptive categories such as rhythmic patterns, vocal techniques, repetition structures, bodily gestures, performer–audience dynamics, and the sociocultural contexts in which performances unfold. In digital environments, the analysis protocol guides the systematic recording of upload metadata, interaction patterns, audience responses, and the narrative re-framings that occur as *nongnong* circulates on online platforms. This

approach enables the researcher to identify how performative features adapt to the aesthetic and temporal constraints of digital formats and how platform-specific mechanisms influence visibility, participation, and reinterpretation. Together, these instruments provide a systematic foundation for aligning offline and online data, allowing the analysis to illuminate shifts in cultural authority, generational participation, and the pedagogical potential that emerges from the digital transformation of the *Nongnong Mbaham* tradition.

Participants were selected using a purposive sampling technique, based on their cultural roles, knowledge authority, and relevance to the research objectives. This approach ensured the inclusion of traditional performers and elders as custodians of cultural knowledge, teachers and students as educational actors, and youth as emerging digital participants, thereby capturing both cultural continuity and transformation across generations.Data analysis followed an interactive and recursive process involving continuous movement between fieldnotes, interview transcripts, digital artefacts, and emergent thematic patterns. The analytical procedure included reducing raw data into core conceptual units, identifying thematic relationships across offline and online contexts, and organizing multimodal evidence into coherent interpretive categories. Multimodal performance analysis was applied to examine vocal patterns, repetition structures, rhythmic sequences, and embodied gestures within *nongnong* performances. Digital-trace analysis was used to interpret patterns of circulation, platform-mediated visibility, interactivity, and the narrative alterations occurring in digital environments. Contextual-educational coding was incorporated to identify cultural values and pedagogical elements that could support the development of contextual learning models. The analysis was concluded through the synthesis of offline and online data to reveal how *Nongnong Mbaham* transforms, persists, and acquires new meaning within the contemporary digital landscape. Trustworthiness of the data was ensured through prolonged field engagement, triangulation of data sources (interviews, observations, and digital artefacts), and iterative reflective analysis, enhancing the credibility and dependability of the findings.

Table 1. Analytical Constructs, Data Sources, and Indicators

Analytical Construct	Definition	Data Sources	Qualitative Indicators
Cultural Meaning of Nongnong	Sociocultural values, moral teachings, and genealogical knowledge embedded in Nongnong Mbaham	Interviews with elders and performers; live performance observation	Recurrent themes of kinship, ancestry, moral guidance, ritual references
Performative Structure	Rhythmic, vocal, and embodied features of Nongnong performance	Performative observation sheets; audio-visual recordings	Rhythm patterns, repetition structures, vocal modulation, bodily gestures
Digital Transformation	Changes in form, circulation, and participation as Nongnong moves into digital spaces	Social media posts, shared videos, online comments	Shortened performances, remixing, platform-specific adaptations, audience interaction
Cultural Authority and Participation	Shifts in authority and intergenerational roles in offline and online contexts	Interviews; digital-trace analysis	Elder authority, youth reinterpretation, negotiation of legitimacy
Contextual Learning Potential	Pedagogical relevance of Nongnong for contextual and culturally grounded learning	Teacher and student interviews; classroom-related observations	Student engagement, identity reflection, digital literacy, cultural relevance

3. RESULTS AND DISCUSSION
3.1. Nongnong Mbaham as a Living and Transforming Oral Tradition

This finding directly addresses the first research question by demonstrating that Nongnong Mbaham functions as a living oral tradition that sustains cultural meaning, moral transmission, and communal identity within Mbaham society. Field immersion in customary settings confirms that *Nongnong Mbaham* remains a vibrant cultural expression, performed with depth, intention, and rhythmic discipline. Elder performers demonstrate an embodied mastery of melodic lines and genealogical allusions, often emphasizing that chanting *nongnong* is not merely artistic but moral and ancestral duty. During one evening performance, a senior performer stated, *"Nongnong itu kami pakai untuk mengingatkan bahwa kita berasal dari satu darah. Kalau tidak ada nongnong, anak-anak bisa lupa jalan pulang"* (Elder performer, Interview, 2024). This sentiment reflects how *nongnong* operates as a moral compass for the community, continually reaffirming kinship and grounding social identity. Performances emerge spontaneously during ritual gatherings or relaxed communal conversations, revealing that *nongnong* is not confined to formal ceremonies but continues to live in the daily fabric of Mbaham sociality.

As illustrated in Figure 1, *Nongnong Mbaham* unfolds as a collective, embodied performance situated in open communal spaces where elders, adults, and children participate simultaneously. The visual data reveal that the transmission of *nongnong* occurs not through formal instruction but through shared rhythmic engagement, bodily proximity, and intergenerational presence. Elders occupy a central role as initiators of rhythm and tempo, while younger participants learn by observing, responding, and gradually joining the performance. The circular arrangement of performers and instruments emphasizes reciprocity rather than hierarchy, suggesting that cultural knowledge is distributed through participation rather than verbal explanation [25]. This performative configuration supports the analytical claim that *nongnong* functions as a living cultural practice, where learning, social bonding, and identity formation emerge organically within the flow of communal interaction.

Transformation becomes visible when examining how youth interact with the tradition. While elders articulate *nongnong* in lengthy, symbolically dense sequences, younger audiences frequently encounter the chant through short digital clips circulated via messaging groups. These digital fragments, often captured informally by family members, travel far beyond ritual settings. A young respondent shared, *"Saya jarang ikut acara adat, tapi saya tahu suara nongnong dari video yang orang kirim di grup WhatsApp"* (Youth respondent, Interview, 2024). This illustrates a shift: while ritual contexts preserve meaning and authority, digital contexts expand access and exposure [26]. The pathway of transformation—from ritual performance to community recording to platform-based circulation—is captured conceptually in the transformation flow diagram described earlier, showing how *nongnong* increasingly adapts to digital rhythms without losing its roots in ancestral expression.

Figure 1. Communal Performance of Nongnong Mbaham as an Intergenerational Practice of Cultural Transmission

3.2. Intergenerational Tensions and Shifts in Cultural Authority

This section responds to the second research question by revealing how digital circulation reshapes intergenerational participation and reconfigures cultural authority without displacing traditional legitimacy. A clear intergenerational divergence emerges from the interviews. Elders possess deep knowledge of genealogical lines, metaphoric layers, and ritual obligations embedded in *nongnong*. In contrast, many youth express admiration mixed with insecurity. One student reflected, *"Kalau dengar orang tua menyanyi, rasanya indah sekali, tapi saya tidak tahu arti setiap kata. Takut salah kalau coba ikut"* (Student, Interview, 2024). This insecurity stems from diminishing language fluency and reduced participation in customary events, creating a gap in cultural confidence. Even teachers acknowledge that today's learners often lack the linguistic grounding needed to decode *nongnong*'s layers of meaning.

Yet digital circulation complicates this gap by enabling youth to assert new forms of cultural agency [27]. Through online platforms, younger individuals reinterpret *nongnong* with humor, creativity, or informal commentary. A digital comment from a youth user states, *"Versi ini lucu tapi bikin ingat kampung. Nongnong itu suara rumah"* (Youth comment, Digital trace, 2024). Such interactions do not undermine elders' authority; rather, they reveal emerging dual channels of legitimacy—ritual mastery and digital creativity. Elders remain custodians of sacred knowledge, while youth engage in playful reinterpretation that keeps the tradition circulating in contemporary spaces. The coexistence of these voices suggests not conflict but negotiation: a cultural ecology where tradition is both protected and reimagined [28].

3.3. Digital Circulation and the Emergence of a New Cultural Ecology

The digital landscape presents *Nongnong Mbaham* in fragmented yet socially vibrant forms. Short clips on TikTok, Facebook, and WhatsApp groups show rapid spread, diverse audience responses, and creative recontextualizations. Although removed from their ritual context, these digital artefacts generate emotional resonance. During digital-trace observation, a community member wrote, *"Kalau dengar nongnong di timeline, langsung rindu orang tua"* (Community user, Digital trace, 2024). Such expressions reveal that digitization does

not simply erode meaning; it produces new sentimental attachments that bridge physical distance and generational separation.

Multimodal analysis shows that the digital environment reconfigures how the chant is perceived. Sound becomes compressed, rhythm shortened, and visual cues fragmented. Yet these constraints give rise to new interpretive practices, such as remixing or pairing *nongnong* audio with humorous imagery. While this may appear irreverent, it reflects the adaptive nature of folklore within contemporary media ecologies [29]. The conceptual model of three-layer performativity ritual, social, and digital helps explain this coexistence. Ritual performances preserve cosmological grounding; social interaction reinforces communal belonging; and digital reinterpretation broadens participation [30], creating a layered ecosystem in which *nongnong* acquires multiple lives across contexts.

3.4. Educational Potential and the Foundations of Contextual Learning

These findings address the third research question by illustrating how Nongnong Mbaham can be revitalized as a contextual learning resource through digital ethnography. Teachers consistently highlight the pedagogical value of *Nongnong Mbaham*, particularly when cultural materials are integrated through digital tools. One teacher noted, *"Kalau saya putar video nongnong, anak-anak langsung fokus. Mereka tanya macam-macam. Tapi kalau saya jelaskan tanpa contoh, mereka cepat hilang perhatian"* (Teacher, Interview, 2024). This illustrates that audiovisual mediation enhances engagement by bringing texture, emotion, and rhythm into the learning space. Students express similar sentiments. A student admitted, *"Saya suka dengar, tapi kalau suruh jelaskan artinya saya bingung. Lebih gampang belajar dari video"* (Student, Interview, 2024). Such responses reinforce the importance of structured pedagogical scaffolding [31].

The conceptual learning model developed from the findings integrates four domains—linguistic, cultural, social, and digital, each offering distinct learning affordances [32]. The linguistic domain nurtures phonological awareness and local vocabulary [33]; the cultural-values domain encourages reflection on identity and ethics; the social domain fosters collaborative and participatory learning; and the digital domain supports media literacy and creative reinterpretation [34]. When anchored in *nongnong* as a core cultural text, these domains create pathways for contextualized learning that aligns with local identity while engaging contemporary sensibilities. Rather than diluting tradition, digital mediation becomes an entry point that can guide students toward deeper exploration of cultural meaning [35].

3.5. Implications for Digital-Ethnography–Based Contextual Learning Innovation

The findings of this study reveal that *Nongnong Mbaham* possesses a multilayered structure rhythmic, genealogical, ethical, and performative [36], that aligns closely with the principles of contextual learning [37]. At the linguistic level, the patterned repetition, melodic intonation, and poetic parallelism found in *nongnong* provide authentic materials for phonological awareness, vocabulary development, and discourse analysis in indigenous Papuan languages. At the sociocultural level, its narratives activate moral reasoning, communal identity, and kinship-based ethics [38], offering students entry points for exploring values embedded in lived experience rather than abstract instruction [39], [40]. The digital transformation of *nongnong* further expands these possibilities by generating multimodal learning artefacts short clips, remixes, voice recordings, and online interactions—that can be systematically incorporated into classroom inquiry [41]. When teachers utilize these digital fragments alongside offline performance analysis, students gain access to a dual learning environment that deepens cultural comprehension while strengthening media literacy [42].

Digital ethnography plays a central role in this transformation [43], because it provides methodological and pedagogical strategies that connect students to their cultural heritage in relatable ways [44]. Students can be guided to analyze digital-trace patterns [45], compare multiple versions of *nongnong* circulating online, identify changes in rhythm or narrative structure across platforms, or reflect on audience interpretations visible in comment sections [46]. These activities mirror the analytical procedures used in this study, multimodal performance analysis, thematic coding, and platform-based observation, and translate them into classroom practices that cultivate critical thinking [47]. The integration of elders' voices, whether through recorded interviews or performance clips, allows traditional authority to enter the learning space without requiring physical co-presence. This hybrid learning ecology bridges the generational gap identified in the findings, enabling youth to engage with tradition through modes of participation that feel natural and accessible within their digital habitus.

The implications extend beyond instructional technique toward a revitalization-oriented curriculum model [48], [49]. By positioning *nongnong* not as supplementary cultural material but as a central learning resource, educators can cultivate a curriculum that is culturally grounded, digitally responsive, and identity-affirming [50]. Students are not only learning about tradition; they are learning through tradition interpreting its meanings, tracing its transformations, and participating in its renewal. This approach transforms *nongnong* into a learnable and teachable cultural practice that strengthens youth identity across both physical and digital worlds. It positions contextual learning as an active form of cultural revitalization, where digital media are not threats to

tradition but instruments that sustain, expand, and democratize cultural knowledge for the next generation of Mbaham learners.
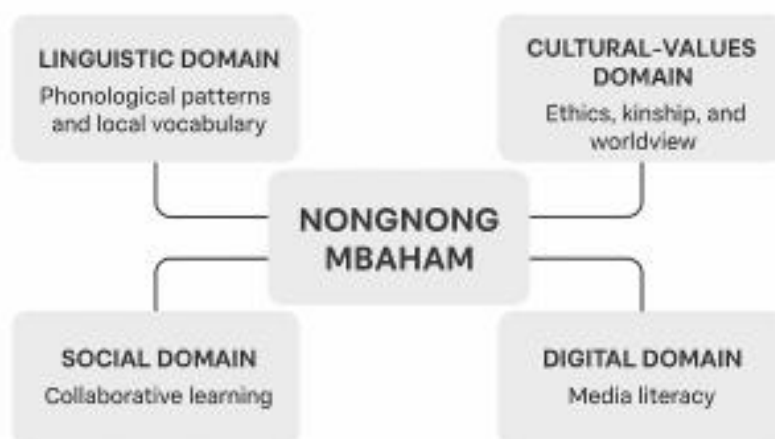

Figure 2. Contextual Learning Model Based On Nongnong Mbaham

The novelty of this study lies in its integrative approach that positions digital ethnography not only as a method of cultural documentation, but as a framework for educational innovation. Unlike previous studies that emphasize preservation or representation, this research demonstrates how an indigenous oral tradition can be systematically transformed into a contextual learning model that strengthens cultural identity, intergenerational learning, and digital literacy. Despite its contributions, this study has several limitations. The findings are grounded in a single indigenous community and do not yet assess the implementation of the proposed learning model in formal classroom settings. Additionally, the qualitative design prioritizes depth of interpretation over generalizability. Future research may empirically test the proposed digital-ethnography-based learning model in formal educational contexts or conduct comparative studies across different Papuan or Indonesian oral traditions. Such studies would further strengthen the generalizability and policy relevance of culturally grounded contextual learning innovations.

4.   CONCLUSION

This study demonstrates that Nongnong Mbaham operates as a dynamic oral tradition whose cultural meanings, performative structures, and modes of transmission continue to evolve within contemporary digital environments while remaining grounded in communal values and intergenerational practice. The findings confirm that digital circulation does not erode cultural integrity; rather, it reconfigures participation, visibility, and learning opportunities across offline and online contexts. Theoretically, this study contributes to the literature on oral tradition and digital ethnography by showing that performativity, cultural authority, and transmission are not displaced by digital media but are rearticulated through new forms of mediation and engagement. Digital ethnography is advanced beyond documentation toward an analytical framework that captures cultural continuity within technological transformation, positioning indigenous oral traditions as dynamic knowledge systems within digital ecologies. From an educational and policy perspective, the findings highlight the potential of integrating indigenous oral traditions as core resources for contextual learning. The proposed digital-ethnography–based model provides a practical framework for developing culturally grounded curricula that strengthen cultural identity, intergenerational learning, and digital literacy, particularly in regions with strong indigenous heritage such as Papua. These insights offer policy-relevant guidance for incorporating community-based digital cultural materials into formal education systems. Future research may focus on empirical classroom implementation and comparative studies across indigenous contexts to further inform educational innovation and cultural policy development.

AUTHOR CONTRIBUTIONS

Conceptualization, A.V.S.L. and R.D.B.R.; Methodology, A.V.S.L.; Software, S.D.; Validation, A.V.S.L., R.D.B.R., and S.M.; Formal Analysis, A.V.S.L.; Investigation, A.V.S.L.; Resources, R.D.B.R.; Data Curation, S.D.; Writing – Original Draft Preparation, A.V.S.L.; Writing – Review & Editing, A.V.S.L., R.D.B.R., and S.M.; Visualization, S.D.; Supervision, R.D.B.R.; Project Administration, A.V.S.L.; Funding Acquisition, S.M.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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