Wura Bongi Monca dance as a promising context for fostering problem-solving skills in learning set theory

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Abstract

The *Wura Bongi Monca* dance embodies the philosophical values of Bima culture, which can be contextualized to facilitate students' understanding of abstract mathematical concepts, such as set theory. Although most ethnomathematics research has focused on concrete elements such as geometric shapes and numerical patterns in cultural practices, little attention has been given to how cultural values can support the teaching of abstract topics. Yet, local traditions hold significant potential to provide meaningful contexts for such learning. This study addresses that gap by investigating the traditional Bima dance *Wura Bongi Monca* as a contextual learning resource to introduce set theory and enhance students' problem-solving skills. Problem-solving is a key mathematical competency, indicating conceptual understanding, critical thinking, and the ability to apply knowledge in new situations. It also serves as a benchmark for evaluating the impact of culturally contextualized instruction. Using an ethnography approach including literature review, field observations, and interviews with cultural experts, the study interprets the symbolic meanings of *Gerak Wura*, the dance's core movements, and connects them to set theory concepts. The findings demonstrate that dance can foster conceptual understanding and cultural awareness, support culturally responsive mathematics education while preserving local heritage and providing insights for innovative instructional design.

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Introduction

Mathematics education in Indonesia continues to face critical challenges, particularly in the dominance of a normative-dogmatic instructional paradigm. This approach tends to portray mathematics as an abstract and decontextualized discipline, disconnected from students' socio-cultural realities. Consequently, students often struggle to develop deep, meaningful, and conceptually rich understandings of mathematical ideas (Ernest et al., 2016; Valeeva et al., 2023). One of the most pressing outcomes of such pedagogical disconnection is the persistently low level of students' mathematical problem-solving abilities, as consistently reported in national studies and international assessments such as PISA and TIMSS (Hadi et al., 2023; Hasanah et al., 2019; OECD, 2023).

A particularly evident manifestation of this issue arises in students' difficulties with foundational mathematical content, such as set theory. Recent studies (e.g., Hendriyanto et al. (2024)) have documented significant epistemological obstacles among students in grasping basic set-theoretic concepts, including notation, classification, and the comparison of sets. Students often exhibit limited ability to transfer conceptual understanding to non-routine or higher-order problem-solving contexts. This is concerning given the foundational role of set theory in the structure of mathematics: all mathematical objects and formal systems are ultimately rooted in set-theoretic foundations (Maddy, 2007) and understanding set theory is essential for engaging with more advanced topics across mathematical domains.

Despite its significance, literature analysis reveals a critical gap in the availability of effective, contextually rich pedagogical strategies for teaching set theory. For instance, Fischbein and Baltsan (1998) documented conceptual misunderstandings among teachers in contextualizing set theory. More recently, Akar and Işıksal-Bostan (2024) highlighted a substantial misalignment between the intended curriculum and the actual content delivered in classrooms, resulting in learning barriers that negatively affect students' problem-solving capabilities.

Furthermore, Indonesian mathematics education suffers from a persistent scarcity of culturally relevant instructional resources. Many educators rely on conventional, lecture-based teaching methods emphasizing rote memorization and procedural fluency, thereby reinforcing an abstract and disconnected vision of mathematics (Prahmana et al., 2025; Valeeva et al., 2023). This instructional climate often renders mathematics irrelevant to students lived experiences, further diminishing engagement and conceptual understanding.

To address these challenges, recent research has highlighted the potential of integrating local cultural elements into mathematics instruction—an approach grounded in ethnomathematical theory. Ethnomathematics enables learners to develop mathematical understanding through cultural practices that are familiar and meaningful to them, fostering both cognitive engagement and affective connection (Khasanah et al., 2025; Prahmana & Istiandaru, 2021; Pujiastuti et al., 2025). Cultural artifacts, such as traditional games, architecture, and geometric patterns, have been widely explored in Indonesian ethnomathematics research (Alghiffari et al., 2024; Radiusman et al., 2021; Wiri et al., 2023).

However, the pedagogical potential of traditional dance—particularly as a medium for teaching abstract concepts such as set theory—remains underexplored.

Traditional dance, as a rich form of cultural expression, embodies mathematical structures, spatial patterns, and symbolic representations that can be effectively leveraged to introduce and contextualize mathematical concepts. Prior studies have demonstrated the integration of traditional dances—such as the Balinese dance (Apsari & Abrahamson, 2024; Radiusman et al., 2021), the *Zapin* and *Kuda* dances (Abdullah et al., 2025), the *Ped'Oa* dance of the Sabu community (Wiri et al., 2023), and the crazy Bamboo dance supported by GeoGebra classroom (Mataheru et al., 2023)—in mathematics instruction, including the development of culturally responsive teaching materials. Within this framework, the *Wura Bongi Monca* dance of the Bima community in West Nusa Tenggara presents distinctive potential for illustrating set-theoretic concepts through culturally grounded movement patterns and symbolic gestures. However, to date, no research has explored the pedagogical use of *Wura Bongi Monca* in the context of set theory instruction.

This study addresses this research gap by investigating the integration of the *Wura Bongi Monca* traditional dance into the teaching of set theory within the Indonesian mathematics curriculum. The research aims to explore how the elements of *Wura Bongi Monca* can be mathematically interpreted to represent set-theoretic concepts, examine how this cultural integration supports students' understanding and problem-solving in set theory, and contribute to the development of culturally responsive mathematics education practices. The novelty of this study lies in its representation of traditional dance movements as visual and conceptual models of sets, thereby offering a meaningful, affectively engaging, and culturally relevant instructional strategy. This approach also serves the dual purpose of enriching students' mathematical understanding and preserving local cultural heritage through integrative pedagogy.

Methods

This study employs a qualitative ethnographic approach to explore the cultural dimensions of the traditional *Wura Bongi Monca* dance and its relevance as a contextual medium for learning set theory. Ethnography was chosen because it enables researchers to gain a deep understanding of cultural practices from an insider (emic) perspective, and it supports the interpretation of symbolic and structural elements in traditional dance as potential representations of mathematical concepts, particularly set theory (Creswell & Poth, 2016; Spradley, 1980). In this study, the ethnographic approach is applied through several systematic steps: (1) participatory observation of the *Wura Bongi Monca* dance performance in its original cultural context; (2) in-depth interviews with cultural practitioners and local cultural educators to obtain perspectives and symbolic meanings of each dance element; (3) documentation and interpretation of the movement structures, group formations, and dance attributes that relate to set theory concepts; and (4) qualitative analysis of the data to identify mathematical representations emerging from these cultural elements. The main focus of this study is to conduct an in-depth analysis of the components of the *Wura Bongi Monca* dance that

symbolically and structurally represent fundamental concepts in set theory, such as membership, relationships between sets.

The research was conducted in two culturally significant locations in Bima, West Nusa Tenggara, Indonesia: *Sanggar Pasole Sila*, located in Bolo Subdistrict, and the Bima Sultanate Museum (*ASI Mbojo*) in the city of Bima. Participants were selected purposively, consisting of the head and sole choreographer of *Sanggar Pasole Sila*, and a Bima cultural expert with extensive knowledge of traditional dances, including *Wura Bongi Monca*. The selection was based on their cultural authority and expertise, ensuring the acquisition of rich, authentic, and meaningful data (Patton, 2002). These key informants were deemed essential for uncovering the historical and symbolic values embedded in the dance, which could be contextualized as foundational elements in the teaching of mathematical set theory.

Data in this study were collected through three main methods: participatory observation, visual documentation, and in-depth interviews. Participatory observation was conducted directly during practice sessions and live performances of the *Wura Bongi Monca* dance to observe spatial formations, movement patterns, group dynamics, and the use of attributes by the dancers. The observation instrument was organized in a structured observation sheet with indicators including the form and direction of movements, floor patterns and group formations, use of dance properties or attributes, and interaction among dancers within the cultural context. Visual documentation, in the form of photographs and video recordings, was used as supporting data to facilitate structural and symbolic analysis of the dance elements. Meanwhile, in-depth interviews were conducted with two key informants: the head of the dance studio (senior dancer) and a Bima cultural expert. The interview instrument was designed as a semi-structured interview guide with indicators covering the philosophical meanings behind dance movements, cultural values embedded in the attributes and formations, the process of transmission and preservation of the dance, and the potential of the dance for development as a learning medium. These three methods were employed in a triangulated manner to obtain a comprehensive and in-depth understanding of the relevance of the *Wura Bongi Monca* dance in representing mathematical concepts, particularly set theory.

To enhance the educational relevance of the findings' triangulated interviews were also conducted with a local mathematics teacher to obtain pedagogical insights and validate the feasibility of integrating dance elements into mathematics instruction. Methodological and source triangulation was employed to enhance the trustworthiness and credibility of the data, through cross-verification of observations, interview accounts, and visual evidence (Denzin, 2012). All interviews were audio-recorded, transcribed verbatim, and subsequently analyzed to identify implicit and explicit references to set theory concepts.

The data were analyzed using a qualitative interpretive approach, involving the examination of field notes, interview transcripts, visual recordings, and relevant literature. The goal of analysis was to identify mathematical elements, particularly those related to set theory—such as grouping, classification, intersections, and disjoint sets—embedded within the choreographic structure of the *Wura Bongi Monca* dance. A coding scheme was developed to map dance components to mathematical representations. Triangulation of data sources, and

analytic strategies was employed to ensure validity by cross-referencing emerging themes across interview narratives, observational records, and scholarly references.

The study adhered to ethical research principles as outlined by Chenhall et al. (2011). Written informed consent was obtained from all participants prior to interviews and visual documentation. Participants' identities were anonymized in all research outputs to preserve confidentiality. Furthermore, cultural sensitivity was maintained throughout the research process, ensuring that traditional practices were respected and not disrupted during observations or interviews.

Finally, researchers' reflexivity was maintained throughout the study to account for potential biases stemming from the researchers' academic background in mathematics education. Acknowledging the influence of personal academic assumptions, the researchers actively engaged in self-reflection and remained open to indigenous perspectives. Reflexivity was operationalized by documenting personal responses and interpretive reflections during fieldwork and by regularly consulting with participants to verify interpretations. This approach was crucial in maintaining the integrity of cultural representations while ensuring accurate mapping between traditional dance practices and the abstract principles of set theory.

Results

This study explores the traditional dance *Wura Bongi Monca*, a cultural performance commonly showcased during various ceremonial events by the Bima community. The dance consists of distinctive movements rooted in the legacy of the Bima Sultanate, along with additional choreography developed by local dance studios. By recognizing the philosophical meanings embedded in both the royal-origin movements and those adapted by the studios, this research seeks to contextualize cultural expressions within mathematical concepts—specifically, set theory. The following sections present the findings of the exploration, highlighting the connections between traditional dance movements, set theory concepts, and the philosophical values inherent in the dance.

Introducing the concept of universal set through the *Wura Bongi Monca* dance

In mathematics, a universal set is defined as a set that contains all elements under discussion within a particular context. In the context of the *Wura Bongi Monca* dance from Bima, there are two primary movement categories: traditional movements originating from the Sultanate of Bima, and choreographic innovations from dance studios such as *Sanggar Pasole*. For example:

Set A = Movements from *Sanggar Pasole Sila*
Set B = Movements from the Bima Sultanate
Therefore, Universal Set S = {X | X is a movement in the *Wura Bongi Monca* dance}

Figure 1 provides students with a contextual understanding of universal sets through local culture. As Rosa and Orey (2011) emphasizes, culturally contextualized mathematics instruction helps students develop a deeper conceptual understanding.
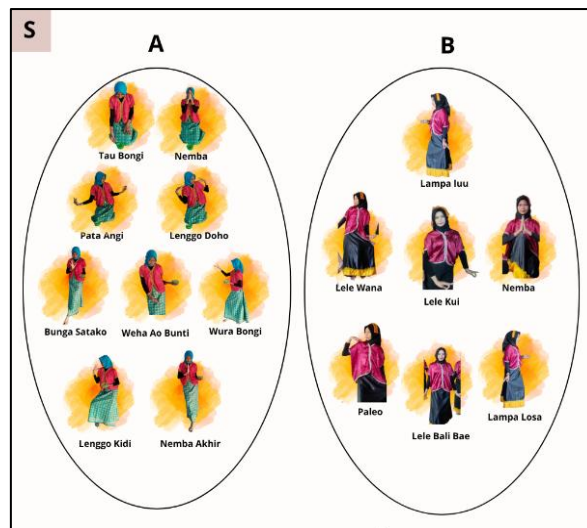
Figure 1. The traditional movements of the *Wura Bongi Monca* dance form a universal set

Furthermore, Table 1 presents several essential terms and movements associated with the traditional *Wura Bongi Monca* dance of Bima, Indonesia. Each term is derived from the Bima language and carries symbolic meanings that reflect cultural values such as respect, hospitality, prosperity, and harmony.

Table 1. Key terms and movements in the *Wura Bongi Monca* dance of Bima culture

No	Term	Definition
1	*Nemba*	In the Bima language, *nemba* signifies greeting, respect, and reverence. In the context of dance, it represents a gesture of honour toward visiting guests, reflecting the Bima community's belief that guests are dignified figures and bearers of blessings.
2	*Tau Bongi*	Literally refers to the act of placing rice into a container. Within the dance, it symbolizes prosperity, fertility, and the blessings of Bima's land.
3	*Pata Angi*	Interpreted as social bonding, encompassing kinship, mutual recognition, and mutual assistance.
4	*Lenggo Doho*	Derived from *lenggo* ("high") and *doho* ("sitting"). In the dance, this movement expresses the highest respect to guests in a seated position.
5	*Weha Ao Bunti*	Derived from *weha ao* ("to receive/escort") and *bunti* ("bride"). In the dance, it signifies escorting the bride with grace and honor, preceding the ritual of scattering rice as a symbol of blessing.
6	*Lenggo Kidi*	Derived from *lenggo* ("high") and *kidi* ("standing"). In the dance, this movement represents the utmost respect for guests in a standing position.
7	*Wura Bongi*	Derived from *wura* ("to scatter") and *bongi* ("rice"). *Wura Bongi Monca* refers to the scattering of rice as an expression of gratitude for Bima's abundant natural harvests.
8	*Sanggar Pasole Sila*	An art community in Bima dedicated to teaching and preserving the *Wura Bongi Monca* dance. This group frequently performs at cultural events, weddings, and ceremonies to welcome honoured guests.
9	*Bunga Satako*	A dance movement style developed by *Sanggar Pasole Sila*. It symbolizes a stalk of flower, representing kindness, hospitality, and beauty in both speech and action.

No	Term	Definition
10	*Nemba Akhir*	Denotes the dancers' final gesture of respect in the *Wura Bongi Monca* performance toward honored guests or the audience.
11	*Lampa Luu*	Literally means "to walk into a room." In the dance, this movement symbolizes the beginning of an event, emphasizing that every entrance should be made with humility and respect for others.
12	*Lele Wana*	Derived from *lele* ("tilted") and *wana* ("side"). This movement highlights the grace and hospitality of Bima women.
13	*Lele Kui*	Derived from *lele* ("tilted") and *kui* ("left"). This movement similarly embodies the grace and hospitality of Bima women.
14	*Paleo*	A movement in the *Wura Bongi Monca* dance characterized by placing the hands upon the shoulders.
15	*Lele Bali Bae*	A dance movement symbolizing balance and harmony.
16	*Lampa Losa*	A movement meaning "to walk out," indicating the conclusion of the dance and the final expression of respect to guests and the audience.

Introducing the concept of disjoint Sets through the *Wura Bongi Monca* dance

Two sets are considered disjoint if they have no elements in common and are both non-empty. Within the performance practices of *Sanggar Pasole Sila*, there is a clear separation between the introductory and core movements, with no overlapping elements. For instance:

Set C (Introductory Movements) = {*Nemba, Tau Bongi, Pata Angi, Lenggo Doho*}
Set D (Core Movements) = {*Weha Ao Bunti, Lenggo Kidi, Wura Bongi*}
Sets C and D are disjoint: C ∩ D = ∅

Figure 2 helps students comprehend the concept of disjoint sets by showing that Sets C and D share no common elements.
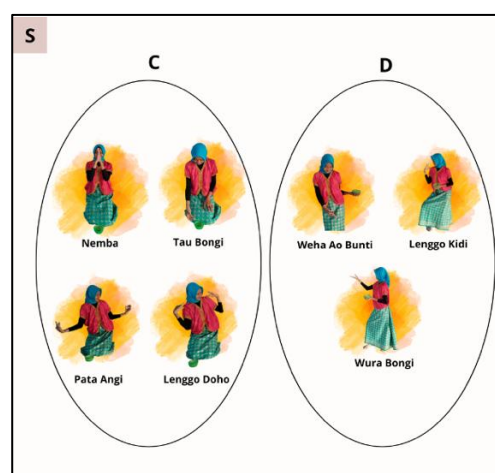

Figure 2. The introductory and core movements in the *Wura Bongi Monca* dance as disjoint sets

Furthermore, Lipka et al. (2005), in their culturally based mathematics education approach in Alaska, underscore the importance of integrating local knowledge as a foundation for developing formal mathematical concepts. Mathematically, this is expressed as:

C = {*Nemba, Tau Bongi, Pata Angi, Lenggo Doho*}
D = {*Weha Ao Bunti, Lenggo Kidi, Wura Bongi*}
Therefore, C ∩ D = ∅ (C and D are disjoint sets).

Introducing the concept of subsets through the *Wura Bongi Monca* dance

In the context of the *Wura Bongi Monca* dance, particularly in the concluding segment performed by *Sanggar Pasole*, certain movements can be identified as subsets of the universal set of movements as illustrated in Figure 3.
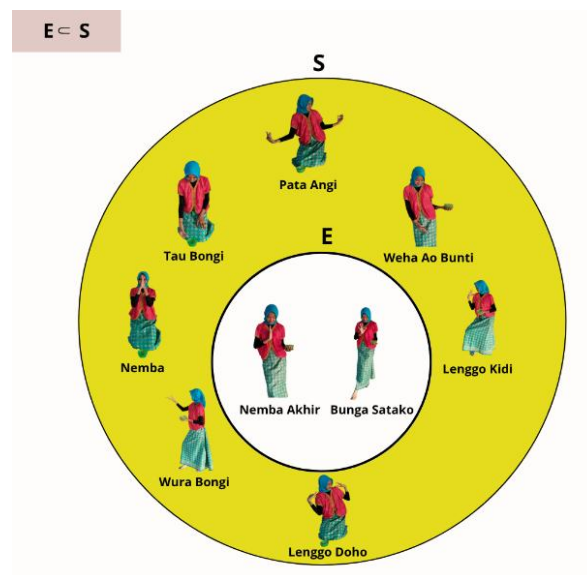

Figure 3. The closing movements in the *Wura Bongi Monca* dance forming a subset

Here, students are introduced to the concept of subsets: E ⊆ S, read as "E is a subset of S", because every element in E also belongs to the universal set S. For instance, the subset of closing movements includes:

{} ⊆ E
{*Nemba Akhir*} ⊆ E
{*Bunga Satako*} ⊆ E
{*Nemba Akhir, Bunga Satako*} ⊆ E

A set E is considered a subset of S if and only if every element of E is also an element of assert that contextual cultural approaches such as this can facilitate students' understanding of formal mathematics through more accessible and relatable means.

Introducing the concept of intersection through the *Wura Bongi Monca* dance

The intersection of two sets refers to a set containing all elements that are common to both sets in the version of the *Wura Bongi Monca* dance originating from the Bima Sultanate, certain movements such as *Nemba* appear in both the opening and closing segments. For example:

$$F = \{Nemba, Lampa\ Luu\}$$
$$G = \{Nemba, Weha\ Ao\ Bunti\}$$
$$F \cap G = \{Nemba\}$$

This concept introduces students to the idea of intersection as a representation of similarity amidst diversity as shown in Figure 4. D'Ambrosio (2016) emphasized the importance of recognizing mathematical structures within cultural practices a core tenet of ethnomathematics.
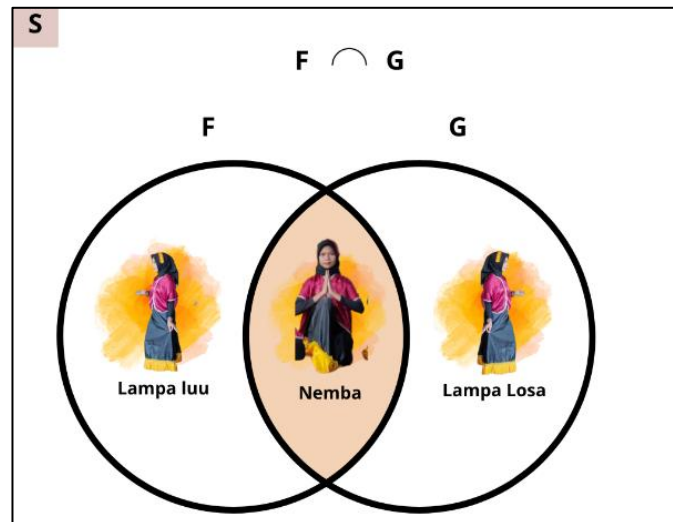

Figure 4. The intersection of opening and closing movements in the Sultanate version of the *Wura Bongi Monca* dance

Introducing the concept of complement through the *Wura Bongi Monca* dance

The complement of a set consists of all elements in the universal set that are not in the given set. For example:

Universal Set S = {*Lampa Luu, Nemba, Lele Wana, Lele Kui, Lele Bali Bae, Paleo, Lampa Losa*}

Set H = {*Lele Wana, Lele Kui, Lele Bali Bae, Paleo*}

Therefore, H^c = {*Lampa Luu, Nemba, Lampa Losa*}

This concept helps students grasp the idea of exclusion within a larger set, enhancing their abilities in categorization and systematic thinking illustrated in Figure 5.
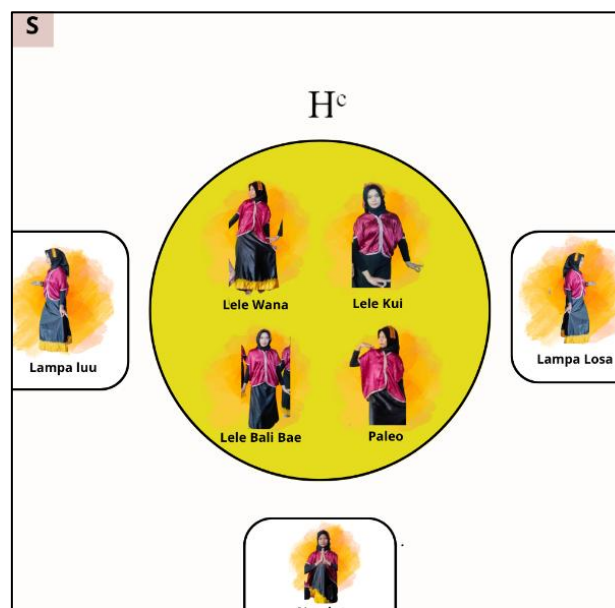
Figure 5. The core movements in the Sultanate version of the *Wura Bongi Monca* dance illustrating set complement

Historical and cultural values of Bima as enhancers of students' affective knowledge in preserving cultural diversity

The *Wura Bongi Monca* dance from Bima transcends aesthetic expression by embodying profound historical and philosophical values. As part of Bima's cultural heritage, the dance reflects the community's worldview, social systems, and Islamic values internalized over time. When incorporated into mathematics education—especially in introducing set theory concepts—the dance functions not only as a contextual medium but also as an affective educational instrument that reinforces students' cultural identity and tolerance for diversity. emphasized the critical role of affective dimensions in fostering emotional engagement between students and culturally meaningful content.

By recognizing and interpreting cultural symbols embedded in dance movements, costumes, and choreography, students develop not only cognitive understanding of abstract mathematics but also empathy, respect, and pride in their local culture. Interviews with Bima cultural experts identify five primary philosophical values in *Wura Bongi Monca* that can be instilled in students presented in Table 2.

Embedding these philosophical values within mathematics instruction provides an avenue for students to engage in reflective learning. At the conclusion of a lesson, educators are encouraged to facilitate student reflection that connects mathematical concepts—such as subsets or intersections to the cultural values embedded in the movement sequences and attire of the *Wura Bongi Monca* dance. This approach deepens the relevance of mathematical learning by creating a bridge between abstract logical reasoning and sociocultural understanding.

Such integration resonates with perspective on ethnomathematics, which advocates for mathematics education that reflects and honors local cultural practices. In doing so, it promotes

intercultural awareness and humanistic values within mathematics instruction. Thus, culturally contextualized mathematics learning through traditional dance media like *Wura Bongi Monca* not only enhances students' cognitive understanding but also strengthens their affective connection to their cultural identity. This is essential in fostering a generation of learners who are not only academically competent but also socially responsible and committed to the preservation of national cultural heritage.

Table 2. Philosophical values embedded in the traditional *Wura Bongi Monca* dance

No	Term	Philosophical Meaning
1	*Wura Bonggi Monca*	Symbolizes fertility and blessings in the land of Bima, community prosperity, and the dignity of hospitality. It emphasizes the value of *silaturahmi* (social harmony and bonding) in Islamic culture, represented by the color *monca* (yellow).
2	Opening Movements	Embody respect and the significance of nurturing relationships among people, upholding human dignity.
3	Core Movements	Represent the hospitality and gentleness of Bima women in welcoming esteemed guests, who are viewed as symbols of honor.
4	Closing Movements	Reflect the kindness extended to the general public and highlight the deep respect given to all individuals.
5	*Bajo Bodo* (dance costume)	Symbolizes unity, harmony, and aesthetic beauty, captivating the audience through visual coherence and elegance.

The implications of this study indicate that integrating local culture into mathematics education can serve as a transformative approach for the future of education. This approach not only enriches curriculum design with socially relevant contexts but also fosters the development of a more inclusive, reflective generation of learners with strong cultural awareness. Therefore, further research is recommended to develop culturally based learning models from various regions in Indonesia that can connect local values with a wide range of mathematical concepts, in order to build an education system that is adaptive to diversity and global challenges.

Discussion

Mathematical understanding is deeply linked to the social and cultural context in which learners are situated (Rosa & Orey, 2011). Mathematics is innately interconnected with everyday human activities and cultural expressions, encompassing a wide range of applications, from routine calculations and classification tasks to artistic forms, such as traditional dance (Radiusman et al., 2021). Furthermore, Apsari and Abrahamson (2024) make a significant contribution to geometry education through the development of Geometry Resources in Dance (GRiD), a low-cost diagrammatic floor mat grounded in Balinese dance practice. Their study demonstrates how GRiD supports students in constructing and interpreting auxiliary lines by engaging in embodied, multimodal, and socially mediated reasoning. This pedagogical approach bridges

perceptual-motor experiences with formal geometric argumentation, thereby deepening students' conceptual understanding of geometric principles.

Traditional dance has the potential to serve as a starting point or context for creating learning designs for elementary and middle school children. Furthermore, research by Sulistyawati et al. (2025) identified seventeen mathematical concepts embedded within the exploration of the *Remo* dance, specifically through its elements of movement, costume accessories, and accompanying musical instruments. Their study demonstrated an almost perfect level of reliability. These findings indicate that the cultural context of the *Remo* dance holds significant potential as a source for mathematics instruction, particularly in designing learning activities, developing instructional materials, and constructing assessment instruments.

In the context of this research, the *Wura Bongi Monca* dance from Bima serves not only as a cultural expression but also incorporates mathematical structures into its movement patterns. This dance exemplifies mathematical elements through movement components performed by a group of dancers, which are then represented in set theory concepts, such as universal sets, disjoint sets, subsets, intersections, and complements of sets. Incorporating local cultural elements into mathematics education enables students to recognize mathematics as a fundamental aspect of their cultural traditions (Novikasari et al., 2024).

The integration of cultural contexts into mathematics education facilitates the connection between students lived experiences and abstract mathematical concepts (Pujiastuti et al., 2025). This approach is consistent with the principles of contextual learning, which emphasize linking academic content to students' immediate environments (Ergene et al., 2020; Fadilah et al., 2024). Moreover, embedding cultural contexts in mathematics instruction has been shown to strengthen students' problem-solving abilities (Yanti, 2025). Given Indonesia's diverse and rich cultural heritage, such an approach holds significant potential for fostering meaningful mathematics learning within the national educational context.

Susanti and Ulum (2021) highlight that the mathematical concepts illustrated in the *Beskalan Putri Malang* dance encompass geometric transformations, including translation, rotation, reflection, dilation, and transformation composition. This finding makes the dance a valuable resource for contextual mathematics learning for high school students. Furthermore, research by Abdullah et al. (2025) developed a teaching module that integrates the *Zapin* and *Kuda Kepang* dances with isometric transformations. The findings of this study reveal the potential for integrating elements of traditional dance into mathematics education to foster deeper engagement and academic success, underscoring the need for innovative teaching approaches in secondary education. In the context of this research, especially in Bima, there has not been much exploration of traditional dance as a learning resource, therefore, the *Wura Bongi Monca* dance can be an alternative as a context in mathematics learning related to the material of universal sets, disjoint sets, subsets, intersections of sets, and complements of sets. Additionally, integrating local culture into mathematics education helps preserve intangible cultural heritage. This approach allows students to engage not only in learning mathematics but also in appreciating and maintaining their cultural identity. Thus, utilizing traditional dance as a teaching medium is a meaningful way to preserve culture while simultaneously enhancing the quality of mathematics education.

Several studies have demonstrated that the integration of set theory concepts into culture-based mathematics education carries significant theoretical and practical implications (Prahmana & Istiandaru, 2021; Yılmaz, 2020). The *Wura Bongi Monca* dance serves as a cultural medium that illustrates various set operations, including the universal set, subset, intersection, disjoint set, and complement. The use of dance movements as concrete objects facilitates students' understanding of abstract mathematical concepts by linking them to cultural experiences and identities.

Practically, incorporating local culture promotes contextual and meaningful learning. Introducing set theory through the grouping of *Wura Bongi Monca* dance movements helps students understand mathematical symbolism and notation while understanding the cultural meanings underlying these structures. Context-based learning approaches, such as the mathematics in cultural context studied by Lipka et al. (2005), have demonstrated that indigenous students achieve better learning outcomes when mathematics is taught within culturally relevant contexts.

Theoretically, this integration enriches mathematics pedagogy by bringing sociocultural dimensions into the learning process (Prahmana, 2022). Theories of situated learning and culturally relevant pedagogy support the idea that learning is most effective when it is grounded in the social and cultural realities of students (Ladson-Billings, 1995; Lave & Wenger, 1991). In this context, the *Wura Bongi Monca* dance serves not only as an illustrative tool but also as a representative structure of community practices that reflect classification, sorting, and relational systems consistent with basic set theory concepts.

Thus, the application of *Wura Bongi Monca* in the teaching of set theory not only diversifies pedagogical strategies but also affirms mathematics as a cultural practice. Such integration aligns with (D'Ambrosio, 1989) view on ethnomathematics, which promotes mathematics education that acknowledges and values local cultural practices. This approach fosters intercultural awareness and humanistic values in the teaching of mathematics (Prahmana, 2022). Therefore, culturally contextualized mathematics learning through traditional dance media such as *Wura Bongi Monca* not only impacts students' cognitive understanding but also strengthens their affective connection with their cultural identity. This is essential for cultivating a generation of learners who are not only academically competent but also socially responsible and dedicated to preserving their national cultural heritage.

Conclusion

This study highlights the pedagogical potential of integrating the traditional *Wura Bongi Monca* dance into the teaching of set theory through an ethnomathematical lens. By leveraging the representational elements inherent in the dance, students were able to develop a more concrete and culturally meaningful understanding of fundamental set theory concepts, including universal sets, intersections, subsets, disjoint sets, and complements. The integration of cultural artifacts facilitated not only cognitive engagement but also affective development, as students connected mathematical ideas with philosophical values embedded in the dance, such as *silaturahmi* (social harmony), respect, gentleness, and unity. These findings underscore the

value of culturally contextualized instruction in fostering students' conceptual understanding and promoting culturally situated mathematical problem-solving abilities.

Despite these contributions, the research is not without limitations. The study was conducted within a specific cultural and geographical context—namely, the Bima community in West Nusa Tenggara—and employed a qualitative ethnographic methodology. As such, the findings are inherently context-dependent and may not be readily generalizable to other regions or cultural settings. Moreover, while the study provided in-depth insights into the intersection of cultural practices and mathematics learning, it did not include quantitative assessments of student learning outcomes or comparative analyses with conventional instructional approaches. These methodological constraints call for caution in extrapolating the results and suggest the need for more comprehensive empirical validation in diverse educational contexts.

To advance the field, future research should pursue cross-cultural comparative studies that explore the transferability and scalability of ethnomathematics-based pedagogies across different cultural groups and educational levels. Longitudinal investigations are also warranted to examine the enduring impact of culturally responsive mathematics instruction on students' cognitive development, particularly in relation to mathematical reasoning and problem-solving. Furthermore, the incorporation of digital technologies—such as interactive multimedia representations of traditional cultural practices—may enhance the accessibility and appeal of ethnomathematical content. From a policy perspective, it is imperative that curriculum developers and educational stakeholders support the integration of local cultural knowledge into mathematics instruction through inclusive policies, resource allocation, and collaboration with cultural experts and community members. Such efforts are essential for fostering an equitable and culturally sustaining mathematics education landscape in Indonesia and beyond.

Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript. In addition, the authors have completed the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies.

Author Contributions

Khairullah: Conceptualization, writing–original draft, methodology, formal analysis, editing, investigation, and visualization; **Rully Charitas Indra Prahmana:** Supervision, validation, formal analysis, writing–review & editing, and visualization; and **Nur Robiah Nofikusumawati Peni:** Supervision, validation, writing–review & editing.

References

Abdullah, A. H., Zakaria, M. I., Mokhtar, M., Khairuddin, N. K., Rasol, N. I. A. M., Hanafi, N. H., Suhaimee, N. R. A., Syahri, I., Antoni, A., Susanti, R., & Yuliarni. (2025). The impact of ethnomathematics activities using Zapin and Kuda dances on students' academic achievement and appreciation of isometric transformations. *Mathematics Education Journal*, *19*(2), 299–322. https://doi.org/10.22342/mej.v19i2.pp299-322

Akar, N., & Işıksal-Bostan, M. (2024). The didactic transposition of quadrilaterals: The case of 5th grade in Turkey. *International Journal of Mathematical Education in Science and Technology*, *55*(3), 628–649. https://doi.org/10.1080/0020739X.2021.2022228

Alghiffari, E. K., Prahmana, R. C. I., & Evans, B. (2024). The impact of Ethno-Realistic Mathematics Education-based e-module in strengthening students' problem-solving abilities. *Jurnal Elemen*, *10*(3), 546–566. https://doi.org/10.29408/jel.v10i3.26611

Apsari, R. A., & Abrahamson, D. (2024). Dancing geometry: Imagining auxiliary lines by reflecting on physical movement. *International Journal of Mathematical Education in Science and Technology*, 1–28. https://doi.org/10.1080/0020739X.2024.2427099

Chenhall, R., Senior, K., & Belton, S. (2011). Negotiating human research ethics: Case notes from anthropologists in the field. *Anthropology Today*, *27*(5), 13–17. https://doi.org/10.1111/j.1467-8322.2011.00827.x

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

D'Ambrosio, U. (1989). On ethnomathematics. *Philosophia Mathematica*, *2*(1), 3–14. https://doi.org/10.1093/philmat/s2-4.1.3

Denzin, N. K. (2012). Triangulation 2.0. *Journal of Mixed Methods Research*, *6*(2), 80–88. https://doi.org/10.1177/1558689812437186

Ergene, Ö., Çaylan Ergene, B., & Yazıcı, E. (2020). Ethnomathematics activities: Reflections from the design and implementation process. *Turkish Journal of Computer and Mathematics Education*, *11*(2), 402–437. https://doi.org/10.16949/turkbilmat.688780

Ernest, P., Skovsmose, O., Bendegem, J. P., Bicudo, M., Miarka, R., Kvasz, L., & Moeller, R. (2016). The Philosophy of Mathematics Education. Springer Nature. https://doi.org/10.1007/978-3-319-40569-8_1

Fadilah, N., Dewi, I., & Ahyaningsih, F. (2024). Relationship between mathematics education philosophy and traditional Malay culture in Serampang 12. *Inovasi Kurikulum*, *21*(4), 2331–2346. https://doi.org/10.17509/jik.v21i4.76071.

Fischbein, E., & Baltsan, M. (1998). The mathematical concept of set and the 'collection' model. *Educational Studies in Mathematics*, *37*(1), 1–22. https://doi.org/10.1023/A:1003421206945

Hadi, H., Juandi, D., & Rusdiana, D. (2023). Problem solving ability analysis: Systematic literature review. *Journal of Mathematics and Mathematics Education*, *13*(1), 33–43. https://doi.org/10.20961/jmme.v13i1.73819

Hasanah, S. I., Tafrilyanto, C. F., & Aini, Y. (2019). Mathematical reasoning: The characteristics of students' mathematical abilities in problem solving. *Journal of Physics: Conference Series*, *1188*(1), 012057. https://doi.org/10.1088/1742-6596/1188/1/012057

Hendriyanto, A., Suryadi, D., Juandi, D., Dahlan, J. A., Hidayat, R., Wardat, Y., Sahara, S., & Muhaimin, L. H. (2024). The didactic phenomenon: Deciphering students' learning obstacles in set theory. *Journal on Mathematics Education*, *15*(2), 517–544. https://doi.org/10.22342/jme.v15i2.pp517-544

Khasanah, B. A., Prahmana, R. C. I., Adiputra, S., & Arnal-Palacián, M. (2025). The beauty of mathematics in Indonesian culture: An impactful and meaningful context in number patterns learning. *JRAMathEdu (Journal of Research and Advances in Mathematics Education*, *10*(2), 68–80. https://doi.org/10.23917/jramathedu.v10i2.10441

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, *32*(3), 465–491. https://doi.org/10.3102/00028312032003465

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Lipka, J., Sharp, N., Brenner, B., Yanez, E., & Sharp, F. (2005). The relevance of culturally based curriculum and instruction: The case of Nancy sharp. *Journal of American Indian Education*, *44*(3), 31–54. http://www.jstor.org/stable/24398496

Maddy, P. (2007). *Second philosophy: A naturalistic method*. OUP Oxford.

Mataheru, W., Laurens, T., & Taihuttu, S. M. (2023). The development of geometry learning using traditional dance context assisted by GeoGebra. *Jurnal Elemen*, *9*(1), 65–83. https://doi.org/10.29408/jel.v9i1.6628

Novikasari, I., Muttaqin, A., & Elebiary, N. (2024). Teaching math and preserving culture: The intersection of values in Indonesian pedagogy. In Y. Dede, G. Marschall, & P. Clarkson (Eds.), *Values and Valuing in Mathematics Education*. Springer. https://doi.org/10.1007/978-981-99-9454-0_17

OECD. (2023). PISA 2022 results (Volume I). The state of learning and equity in education. https://doi.org/10.1787/53f23881-en

Patton, M. Q. (2002). Qualitative research and evaluation methods.

Prahmana, R. C. I. (2022). Ethno-realistic mathematics education: The promising learning approach in the city of culture. *SN Social Sciences*, *2*(12), 1–19. https://doi.org/10.1007/s43545-022-00571-w

Prahmana, R. C. I., & Istiandaru, A. (2021). Learning sets theory using shadow puppet: A study of Javanese ethnomathematics. *Mathematics*, *9*(22), 2938. https://doi.org/10.3390/math9222938

Prahmana, R. C. I., Risdiyanti, I., Peni, N. R. N., Ristiana, N., & Ramadhani, R. (2025). Javanese folklore with moral values: An impactful context in learning relations and functions. *Journal on Mathematics Education*, *16*(1), 197–224. https://doi.org/10.22342/jme.v16i1.pp197-224

Pujiastuti, N. I., Prahmana, R. C. I., & Evans, B. (2025). Innovative Ethno-Realistic Mathematics-based modules: Promoting Pancasila values in Indonesian mathematics education. *Jurnal Pendidikan Matematika*, *19*(1), 1–22. https://doi.org/10.22342/jpm.v19i1.pp1-22

Radiusman, R., Wardani, K. S. K., Apsari, R. A., Nurmawanti, I., & Gunawan, G. (2021). Ethnomathematics in Balinese traditional dance: A study of angles in hand gestures. *Journal of Physics: Conference Series*, *1779*(1), 012074. https://doi.org/10.1088/1742-6596/1779/1/012074

Rosa, M., & Orey, D. C. (2011). Ethnomathematics: The cultural aspects of mathematics. *Revista Latinoamericana de Etnomatemática Perspectivas Socioculturales de La*

Educación Matemática, *4*(2), 32–54. https://www.revista.etnomatematica.org/index.php/RevLatEm/article/view/32

Spradley, J. P. (1980). *Participant observation*. Holt, Rinehart, and Winston.

Sulistyawati, E., Nirmala, B. I., & Hamidah, D. (2025). Ethnomathematical exploration of the Remo dance as a source for mathematics learning. *Jurnal Elemen*, *11*(1), 34–49. https://doi.org/10.29408/jel.v11i1.26997

Susanti, E., & Ulum, M. M. (2021, 2021). *The model of etnomathematics for high schools based on the dancers position movement of beskalan putri malang dance* Proceedings of the International Conference on Engineering, Technology and Social Science (ICONETOS 2020, http://dx.doi.org/10.2991/assehr.k.210421.024

Valeeva, R., Biktagirova, G., Lesev, V., Mikhailenko, O., Skudareva, G., & Valentovinis, A. (2023). Exploring the impact of modeling in science education: A systematic review. *Eurasia Journal of Mathematics, Science and Technology Education*, *19*(6), 2284. https://doi.org/10.29333/ejmste/13268

Wiri, P. E. W., Dominikus, W. S., & Udil, P. A. (2023). Ethnomathematics exploration in the Ped'Oa traditional dance of the Sabu community in the Raijua district. *Jurnal Pendidikan Matematika (JUPITEK*, *6*(1), 27–35. https://doi.org/10.30598/jupitekvol6iss1pp27-35

Yanti, S. (2025). The role of ethnomathematics in enhancing contextual mathematics understanding among students. *International Journal of Humanity Advance, Business & Sciences (IJHABS*, *2*(4), 321–330. https://doi.org/10.59971/ijhabs.v2i4.402

Yılmaz, N. (2020). Making the association between culture and mathematics education. *Education Research Highlights in Mathematics, Science and Technology*, 81–104. https://www.isres.org/books/chapters/Erhmst2020-81-104_29-12-2020.pdf