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Ethnomathematics and the Hijri Calendar in Grobogan's Earth Alms Tradition

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Abstract

This study investigates ethnomathematical concepts embedded in the Earth Alms tradition in Karangjati Hamlet, Grobogan Regency, and examines their relationship with Islamic values and the Hijri calendar system. The study responds to the limited integration of cultural and religious contexts in mathematics learning, which often causes mathematics to be perceived as abstract and disconnected from students' daily lives. Using a qualitative ethnographic approach, data were collected through in-depth interviews with traditional leaders, religious leaders, and community members; participatory observations; and documentation studies. Data were analyzed using thematic analysis through coding, categorization, and interpretation processes. The findings reveal that the tradition contains various mathematical concepts, including geometry in the structure of tumpeng and gunung, social arithmetic in the distribution of agricultural products and community contributions, classification in the arrangement of crops, and pattern concepts in cultural processions. The use of the Hijri calendar and Javanese weton system also reflects mathematical ideas related to cycles, periodicity, and time calculation. In addition, the tradition embodies Islamic values such as gratitude, cooperation, charity, and social responsibility. These findings indicate that local traditions can serve as meaningful contextual mathematics learning resources that integrate cultural and spiritual dimensions. This study contributes to the development of culture-based and religion-based mathematics learning through ethnomathematical perspectives.

Keywords: Ethnomathematics; Earth Alms; Hijri Calendar; Contextual Learning; Islamic Values

Abstrak

Penelitian ini mengkaji konsep-konsep etnomatematika yang tertanam dalam tradisi sedekah tanah di Dusun Karangjati, Kabupaten Grobogan, dan meneliti hubungannya dengan nilai-nilai Islam dan sistem kalender Hijriah. Penelitian ini menanggapi terbatasnya integrasi konteks budaya dan agama dalam pembelajaran matematika, yang seringkali menyebabkan matematika dianggap abstrak dan terputus dari kehidupan sehari-hari siswa. Dengan menggunakan pendekatan etnografi kualitatif,

data dikumpulkan melalui wawancara mendalam dengan para pemimpin tradisional, pemimpin agama, dan anggota masyarakat, observasi partisipatif, dan studi dokumentasi. Data dianalisis menggunakan analisis tematik melalui proses pengkodean, kategorisasi, dan interpretasi. Temuan menunjukkan bahwa tradisi tersebut mengandung berbagai konsep matematika, termasuk geometri dalam struktur tumpeng dan gunung, aritmatika sosial dalam distribusi hasil pertanian dan kontribusi masyarakat, klasifikasi dalam pengaturan tanaman, dan konsep pola dalam prosesi budaya. Penggunaan kalender Hijriah dan sistem weton Jawa juga mencerminkan gagasan matematika yang berkaitan dengan siklus, periodisitas, dan perhitungan waktu. Selain itu, tradisi tersebut mewujudkan nilai-nilai Islam seperti rasa syukur, kerja sama, amal, dan tanggung jawab sosial. Temuan ini menunjukkan bahwa tradisi lokal dapat berfungsi sebagai sumber belajar matematika kontekstual yang bermakna dan mengintegrasikan dimensi budaya dan spiritual. Studi ini berkontribusi pada pengembangan pembelajaran matematika berbasis budaya dan agama melalui perspektif etnomatematika.

Kata Kunci: Etnomatematika; Sedekah Bumi; Kalender Hijriah; Pembelajaran Kontekstual; Nilai Islam

Introduction

Mathematics learning aims not only to develop computational abilities but also to help students understand and apply mathematical concepts in everyday life. However, mathematics is often perceived as an abstract subject disconnected from students' real-life experiences. In many classrooms, mathematics learning still emphasizes procedural and textbook-oriented instruction with limited integration of students' social and cultural environments. As a result, students frequently experience difficulties in understanding mathematical concepts meaningfully. Therefore, contextual learning approaches are needed to connect mathematical concepts with situations familiar to students' daily lives.

One approach that can connect mathematics with daily life is ethnomathematics. Ethnomathematics views mathematics as a cultural product that develops through human activities and social practices (D'Ambrosio, 2001). Through ethnomathematics, mathematical concepts can be explored from cultural traditions, local wisdom, and community activities. This approach is highly relevant in Indonesia because Indonesian communities possess diverse cultural traditions containing implicit mathematical concepts related to geometry, patterns, measurements, classifications, and counting systems embedded in everyday practices.

One tradition that can be studied from an ethnomathematical perspective is the Earth Alms (Sedekah Bumi) tradition in Grobogan Regency, Central Java. This

tradition is performed as an expression of gratitude for agricultural harvests and communal prosperity. In its implementation, the tradition contains various mathematical elements, such as timing systems, crop distribution, proportional arrangements, and geometric patterns in the preparation of tumpeng and gununggan (Novitasari et al., 2017). The arrangement of tumpeng showing balance and symmetry can represent the application of geometric concepts in everyday life (Utami et al., 2022). In addition, the implementation of the tradition is closely related to the Hijri calendar system based on lunar calculations and hilal observations associated with astronomy and mathematics (Fauzan et al., 2023). The use of the Hijri calendar in determining the implementation of the tradition also reflects the integration between cultural practices and Islamic values (Rahimin et al., 2024).

Islamic values such as gratitude, charity, togetherness, and mutual cooperation are strongly reflected in the Earth Alms tradition through collective prayers, tahlilan activities, crop sharing, and community participation (Arinda R., 2014). According to Novitasari et al. (2017), the tradition also contains da'wah values in the aspects of aqidah, sharia, and morality. These findings indicate that local cultural traditions contain not only social and cultural dimensions but also spiritual and religious values integrated into community life. The integration of cultural context and Islamic values also has significant potential in mathematics learning because students can learn mathematical concepts through experiences closely related to their social and cultural environments (Rosa & Orey, 2011). Contextual learning based on local culture can increase students' motivation and support meaningful mathematics learning (Anyichie & Butler, 2023).

Previous studies on ethnomathematics have explored mathematical concepts embedded in cultural practices, traditional ceremonies, and contextual learning based on local wisdom. However, most studies mainly focused on cultural or mathematical aspects separately, while research examining the integration between ethnomathematical concepts, Islamic values, and the Hijri calendar system within local traditions remains limited (Richardo, 2020). In particular, studies investigating the Earth Alms tradition in Grobogan from integrated cultural, mathematical, and religious perspectives are still scarce. Therefore, this study offers novelty by integrating ethnomathematical concepts, Islamic values, and the Hijri calendar system simultaneously within the analysis of the Earth Alms tradition. This study is expected to contribute to the development of contextual mathematics

learning based on culture and religion while also supporting the preservation of local cultural traditions.

Based on this background, this study aims to identify ethnomathematical concepts contained in the Earth Alms tradition in Grobogan Regency, analyze the use of the Hijri calendar in determining the implementation of the tradition, and examine the Islamic values embedded in the tradition and their potential integration into mathematics learning.

Method

This study employed a qualitative approach with an ethnographic method to examine the integration of ethnomathematical concepts, Islamic values, and the Hijri calendar system in the Earth Alms (Sedekah Bumi) tradition in Karangjati Hamlet, Grobogan Regency, Central Java. A qualitative approach was chosen because it enables researchers to understand cultural meanings, values, beliefs, and social practices deeply within community life (Creswell, 2018). Meanwhile, the ethnographic method was selected because this study focused on direct participation, systematic observation, and interpretation of cultural practices carried out by community members in their natural setting to obtain a holistic understanding of the tradition (Rosaliza et al., 2023).

The research was conducted in Karangjati Hamlet, Grobogan Regency, Central Java, because the local community still actively preserves the Earth Alms tradition as part of its cultural and religious practices. This tradition contains cultural values, Islamic values, and mathematical concepts relevant to ethnomathematical studies. The participants in this study were selected using purposive sampling based on their knowledge and involvement in the implementation of the tradition (Sugiyono, 2008). The participants consisted of one mathematics teacher, one traditional leader, and one religious leader who were selected purposively based on their knowledge, experience, and active involvement in the implementation of the Earth Alms tradition. These participants were considered information-rich informants who were able to provide in-depth insights into the cultural practices, Islamic values, and mathematical concepts embedded in the tradition. The research was conducted over a one-month period during the implementation of the Earth Alms tradition, including interviews, participatory observations, and documentation activities.

Data collection was carried out through in-depth interviews, participatory observations, and documentation studies. Semi-structured interviews were conducted to explore participants' perspectives regarding the implementation of the Earth Alms tradition, the use of the Hijri calendar, Islamic values embedded in the tradition, and mathematical concepts reflected in cultural activities (Merriam & Tisdell, 2016). The interview process focused on cultural meanings, traditional calculations, symbolic representations, and educational values contained in the tradition. Participatory observation was conducted by directly involving the researcher in traditional activities, such as the preparation of tumpeng and gunungan, crop distribution, communal prayers, and cultural processions, in order to understand cultural phenomena in their natural context (Elvandrani et al., 2021). Meanwhile, documentation studies were used to complement the data through photographs, village archives, written documents, and documentation of ritual activities related to the Earth Alms tradition (Bowen, 2009).

The data obtained were analyzed using thematic analysis through several stages, namely data reduction, coding, categorization, interpretation, and conclusion drawing to identify patterns and meanings within the data (Kiger & Varpio, 2020). This analysis aimed to identify themes related to ethnomathematical concepts, Islamic values, cultural practices, and the use of the Hijri calendar in the Earth Alms tradition. The analysis process was conducted systematically to produce an in-depth interpretation of the relationship between mathematical concepts and community cultural practices (Miles et al., 2014). Data validity was maintained through source and method triangulation by comparing interview results, observational findings, and documentation data (Patton, 2015). In addition, research reliability was strengthened through systematic documentation of the research process and audit trails to ensure the consistency and traceability of the findings (Lincoln & Guba, 1985).

This methodological approach is supported by previous studies showing that ethnomathematics is closely integrated with cultural practices and can serve as a source of contextual mathematics learning (Masamah, 2018). In addition, studies on the Earth Alms tradition indicate that the tradition contains strong cultural, social, religious, and educational values relevant to scientific investigation (Jalil, 2017). Therefore, this method is expected to provide a comprehensive understanding of the relationship between ethnomathematics, Islamic values, and the Hijri calendar

system within the Earth Alms tradition as a basis for developing contextual and culture-based mathematics learning.

Results

The Concept of Ethnomathematics in the Earth Alms Tradition

The results of the study indicate that the Earth Alms tradition in Karangjati Hamlet contains various ethnomathematical concepts embedded in community cultural practices. Based on participatory observations and interviews with traditional and religious leaders as well as a mathematics teacher, concepts such as geometry, arithmetic, patterns, and classification were identified in the arrangement of tumpeng and gunungan, crop distribution, community processions, and the determination of ceremonial schedules based on the Hijri calendar and Javanese weton system. From the geometric aspect, the tumpeng and gunungan structures resembled cone and pyramid forms with layered, proportional, and symmetrical arrangements reflecting concepts of order and spatial organization.



Figure 1. Piles of Agricultural Products and Tumpeng that are Paraded

Arithmetic concepts were identified in social practices during the Earth Alms tradition, particularly in the distribution of meat and communal contributions. Based on interviews and observations, the number of slaughtered animals was adjusted to the number of neighborhood units (RT), while the distribution of meat to residents reflected counting and proportional calculation activities carried out collectively by the community. Classification concepts were identified in the grouping of agricultural products arranged in the gunungan based on type and size. The arrangement showed categorization practices resembling set concepts in mathematics. In addition, pattern concepts were observed in the organization of community processions, where participants walked in regular paired formations

during the ceremonial parade. These arrangements reflected repetitive and orderly patterns observed throughout the traditional activities.



Figure 2. Procession of Residents of Karangjati Hamlet

Thus, the Earth Alms tradition contains various mathematical concepts that arise naturally in people's lives while reflecting philosophical values related to human relationships, culture, and spirituality.

The Utilization of the Hijri Calendar in the Earth Alms Tradition

The findings showed that the implementation of the Earth Alms tradition in Karangjati Hamlet was determined based on the integration of the Hijri calendar and the Javanese weton system. Based on interviews with traditional and religious leaders, the ceremony was usually conducted during the month of Dzulqa'dah between the 15th and 20th days and adjusted to Legi Sunday in the Javanese calendar system. Observations also indicated that the determination of ceremonial schedules involved repeated time cycles and periodic calculations related to lunar-based calendrical practices.

Philosophically, the use of the Hijri calendar in this tradition reflects the community's obedience to Islamic values, especially in maintaining punctuality related to the Islamic calendar system. In addition, the combination of the Hijri calendar and the Javanese weton system shows the harmonization between religious values and local wisdom. This illustrates that people's lives are not only governed by mathematical calculations, but also by spiritual values and traditions that are passed down from generation to generation.

Thus, the use of the Hijri calendar in the Earth Alms tradition not only serves as a time-determiner, but also as a representation of the integration between mathematical concepts, Islamic values, and local culture in people's lives.

Islamic Values in Tradition and Its Potential in Mathematics Learning

The findings showed that Islamic values were integrated into several activities of the Earth Alms tradition, including collective prayers, tahlilan, animal slaughtering, and food-sharing practices conducted by the community. Based on interviews with religious and traditional leaders, these activities were carried out as expressions of gratitude and communal solidarity. Observations also indicated that mathematical concepts appeared in several social practices, such as the distribution of meat, communal contributions, and the determination of ceremonial schedules based on the Hijri calendar system.

Philosophically, this tradition reflects the relationship between humans and God (*hablumminallah*) through prayer and worship, as well as the relationship between fellow humans (*hablumminannas*) through sharing and mutual cooperation. These values show that cultural practices are inseparable from the spiritual dimension that is the foundation of people's lives.

In the context of learning, these findings have the potential to be developed as a contextual mathematics learning resource. The integration of Islamic values and local culture in learning can help students understand mathematical concepts more realistically, while instilling character values such as cooperation, justice, and gratitude. Thus, mathematics learning is not only oriented to the cognitive aspect, but also to the formation of attitudes and values that are relevant to students' lives.

Discussion

The identification of geometric concepts in the arrangement of *tumpeng* and *gunungan* reinforces the idea that mathematical knowledge is embedded in cultural practices and daily community activities. This finding supports d'Ambrosio's (1985) view, the presence of proportional and symmetrical arrangements in ceremonial objects also indicates that local traditions can serve as concrete representations of formal geometric concepts. Similar findings were reported by Utami et al. (2022) and Umbara et al. (2021) who found that traditional cultural structures often contain implicit mathematical principles that can be integrated into contextual mathematics learning.

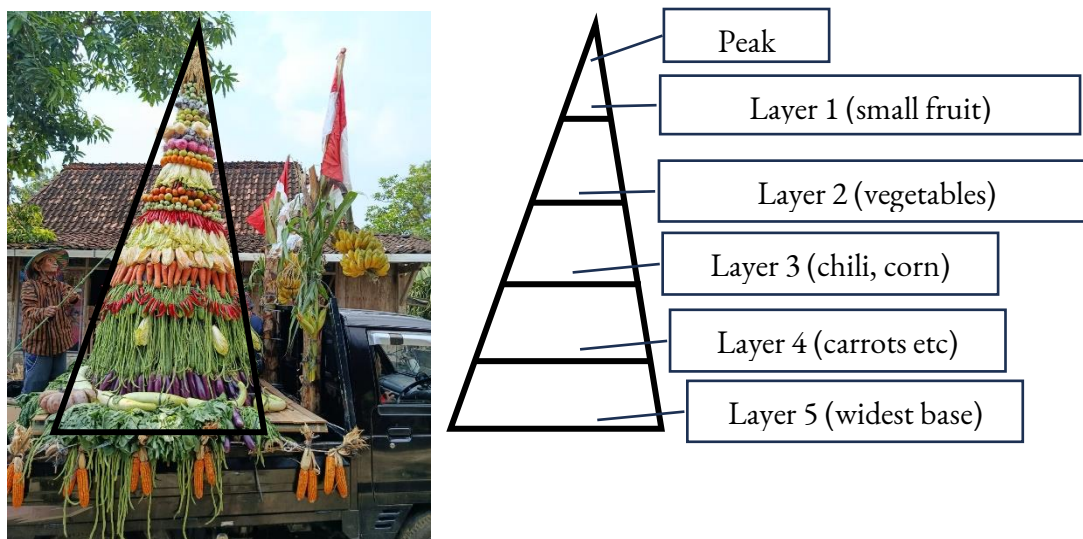


Figure 3. Geometric Structure of Gunungan and Tumpeng

The layered arrangement of gunungan and tumpeng demonstrates how geometric concepts are embedded in local cultural practices. The proportional and symmetrical structures observed in ceremonial objects indicate that traditional communities apply spatial organization and geometric reasoning in cultural activities. These findings suggest that local traditions can provide meaningful and concrete representations of formal geometry concepts within contextual mathematics learning.

The arithmetic and classification practices identified in the Earth Alms tradition indicate that mathematical activities are closely integrated with community social interactions and cultural practices. The distribution of meat, communal contributions, and grouping of agricultural products reflect counting, proportional reasoning, and classification concepts applied in everyday activities. These findings support Bishop's perspective that counting, measuring, and distributing are universal mathematical activities embedded in human culture. Similar findings were also reported by Karina et al. (2021) and Kristanti et al. (2022), who found that cultural grouping practices often represent mathematical concepts related to sets and relationships.

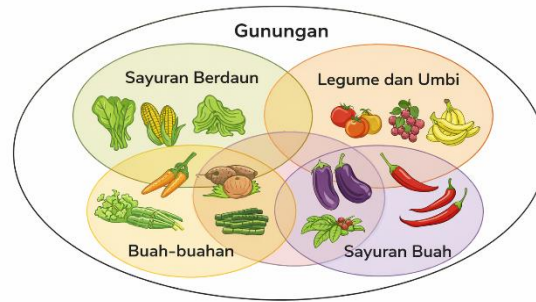


Figure 4. Classification of Crops in the Mountains

In addition, the pattern of community processions that run in pairs shows the concept of patterns and lines. These findings are in line with the research of Kurniawan et al. (2023) and Munawaroh & Supriadi (2021) who stated that patterns in cultural activities can be used to improve students' mathematical modeling skills.

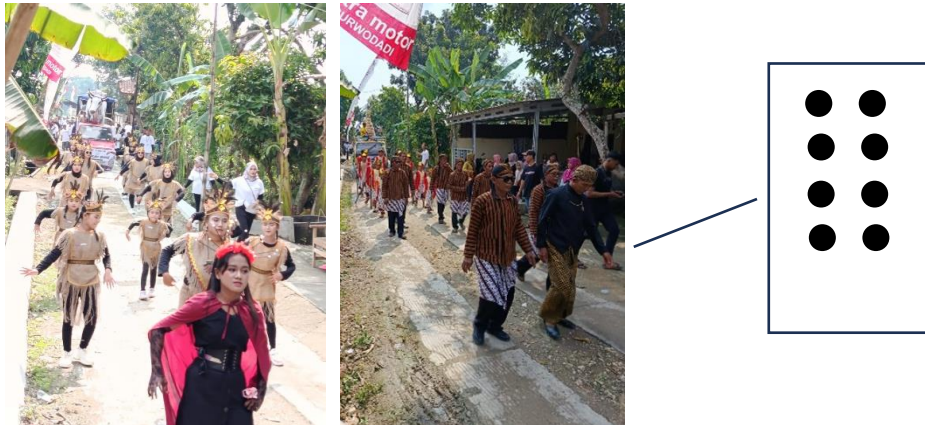


Figure 5. Pattern of Residents' Parade

The repetitive formations observed in community processions indicate the presence of mathematical pattern concepts embedded in cultural activities. The orderly arrangement and consistent spacing between participants demonstrate how local traditions contain structured and repetitive patterns that can be interpreted mathematically. These findings reinforce the role of ethnomathematics in connecting mathematical concepts with cultural experiences and support previous studies showing that cultural activities can serve as meaningful contexts for contextual mathematics learning (Ibrahim & W, 2025; Salsabila et al., 2024).

The integration of the Hijri calendar and the Javanese weton system in determining the implementation of the Earth Alms tradition demonstrates the existence of mathematical reasoning embedded in local calendrical practices. The use of lunar-based calculations, repeated cycles, and periodic time patterns indicates that traditional communities apply mathematical concepts related to

astronomy and temporal measurement in cultural activities. These findings are consistent with studies by Maskufa (2018) and Maskufa et al. (2022) which explained that the Hijri calendar system involves mathematical calculations based on lunar circulation and hilal observation.

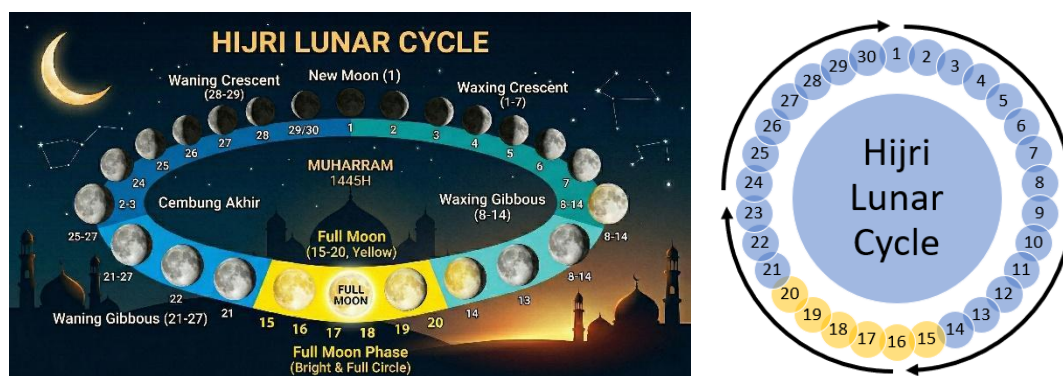


Figure 6. Hijri Calendar Cycle and Traditional Timekeeping

The integration of the Hijri calendar and the weton system demonstrates how traditional communities combine religious and local calendrical practices within cultural activities. This finding indicates that mathematical concepts related to cycles, periodicity, and temporal calculation are embedded in community traditions. Similar findings were reported by Jannah & Yohanes (2022) and Umbara et al. (2021) who found that local communities often integrate different calendrical systems through cultural practices. In addition, the use of the Hijri calendar reflects the preservation of Islamic values, while the weton system represents the continuity of local wisdom within society. These findings suggest that ethnomathematical practices are closely related not only to mathematical reasoning but also to cultural, religious, and astronomical systems embedded in community life (Aris, 2019; Zein & El-Wakil, 2021).

The Earth Alms tradition also reflects Islamic values such as gratitude, charity, togetherness, and mutual cooperation through communal prayers, recitations, animal slaughtering, and food-sharing activities. From an ethnomathematical perspective, these practices are associated with mathematical concepts related to distribution, proportion, and social arithmetic within community interactions. These findings support previous studies by Ibrahim & W (2025) and Sartika et al. (2024) which emphasized that the integration of culture and mathematics can enhance the relevance and meaningfulness of learning.

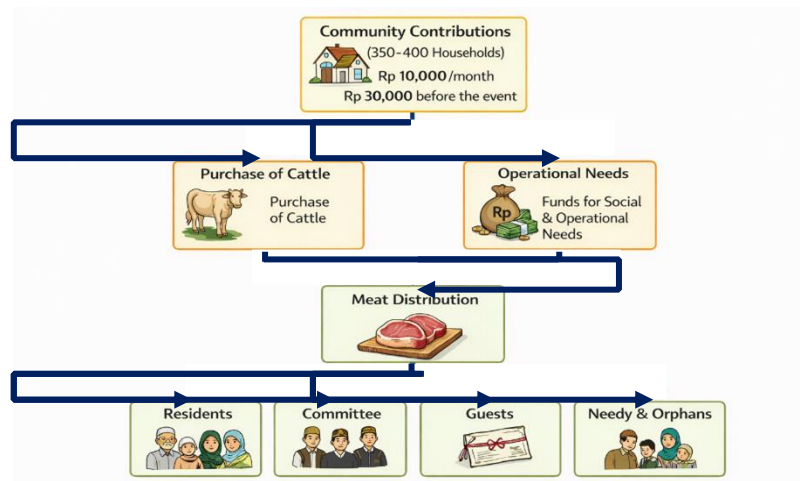


Figure 7. Meat Distribution Scheme and Citizens' Contributions

Figure 7 shows the scheme of community contributions and meat distribution in the Sedekah Bumi tradition. Funds collected from households are used for purchasing cattle and operational needs, and the results are distributed to residents and the community. This process reflects the application of social arithmetic in real-life contexts.

The integration of Islamic values and local cultural practices in the Earth Alms tradition also demonstrates the potential of ethnomathematics as a contextual learning approach. Cultural activities containing mathematical concepts can provide meaningful learning experiences because students are able to relate mathematical ideas to their social and cultural environments. These findings support Rosa & Orey (2011) view that ethnomathematics can enhance students' conceptual understanding through culturally relevant contexts. In addition, culture-based learning has been shown to increase students' motivation and engagement in mathematics learning (Anyichie & Butler, 2023). Therefore, the integration of local culture and Islamic values in mathematics learning can contribute not only to conceptual understanding but also to the development of students' social and cultural awareness.

Conclusion

This study demonstrates that the Earth Alms tradition in Karangjati Hamlet contains various ethnomathematical concepts embedded in community cultural practices, including geometry, arithmetic, patterns, classification, and calendrical calculations related to the Hijri and weton systems. The findings also reveal that Islamic values such as gratitude, charity, togetherness, and mutual cooperation are closely integrated into the implementation of the tradition.

This study contributes to the development of ethnomathematics by demonstrating the integration of mathematical concepts, local culture, Islamic values, and calendrical systems within a single cultural practice. The findings indicate that local traditions can serve as meaningful and contextual resources for mathematics learning while simultaneously supporting cultural preservation and the integration of cultural and religious values in education.

Therefore, the integration of ethnomathematics, local wisdom, and Islamic values has the potential to create more contextual, meaningful, and culturally relevant mathematics learning experiences. Future studies may explore the implementation of culture-based ethnomathematics learning in classroom practices and its impact on students' mathematical understanding and cultural awareness.

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