Ethnomathematics and Philosophical Values in Angklung

Siti Maysarah*[1]; Dian Armanto[2]; Sahat Saragih[3]; Waminton Rajagukguk[4]; Pargaulan Siagian[5]
[1]Mathematics Education Study Program, Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Sumatera Utara, Indonesia
[2,3,4,5]Doctoral Program in Mathematics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Medan, Indonesia
sitimaysarah@uinsu.ac.id*[1], dianarmanto@unimed.ac.id[2], saragihpps@gmail.com[3], warajagukguk@gmail.com[4], pargaulansiagian@yahoo.com[5]

Abstract

Ethnomathematics studies how communities develop and apply mathematical concepts within their cultural contexts. The angklung, a traditional Indonesian musical instrument, represents a meaningful cultural artifact that expresses ethnomathematical principles. The angklung allows people to connect with ethnomathematics because it shows how culture integrates mathematical ideas into daily practices. This study aims to explore: (1) the relationship between mathematical concepts (ethnomathematics) and the traditional musical instrument angklung, and (2) the philosophical values embedded in the angklung. The researchers conducted this study using a qualitative approach at Az-Zaitun Kindergarten in Medan. The researchers applied a descriptive analysis method to clearly and systematically explain the angklung's ethnomathematical aspects and philosophical values. The findings reveal that: (1) the mathematical concepts related to the angklung include geometry, similarity, and combinations; and (2) the philosophical values embedded in the angklung include patriotism, responsibility, discipline, honesty, collaboration, and tolerance.

Keywords: *Ethnomathematics; Philosophical Values; Angklung.*

Abstrak

Etnomatematika mempelajari bagaimana masyarakat mengembangkan dan menerapkan konsep-konsep matematika dalam konteks budaya mereka. Angklung, alat musik tradisional Indonesia, merupakan artefak budaya yang bermakna dan mencerminkan prinsip-prinsip etnomatematika. Angklung memungkinkan orang untuk terhubung dengan etnomatematika karena alat ini menunjukkan bagaimana budaya mengintegrasikan gagasan matematika dalam praktik sehari-hari. Penelitian ini bertujuan untuk mengkaji: (1) hubungan antara konsep-konsep matematika (etnomatematika) dengan alat musik tradisional angklung, dan (2) nilai-nilai filosofis yang terkandung dalam angklung. Peneliti menggunakan pendekatan kualitatif dengan lokasi studi di TK Az-Zaitun, Medan. Metode analisis deskriptif diterapkan untuk menjelaskan secara jelas dan sistematis aspek-aspek etnomatematika serta nilai-nilai filosofis dalam angklung. Temuan penelitian menunjukkan bahwa: (1) konsep matematika yang terkait dengan angklung meliputi geometri, kesebangunan, dan kombinasi; serta (2) nilai-nilai filosofis yang terkandung dalam angklung meliputi patriotisme, tanggung jawab, disiplin, kejujuran, kerja sama, dan toleransi.

Kata Kunci: Etnomatematika; Nilai Filosofis; Angklung.

*Correspondence:
Email: sitimaysarah@uinsu.ac.id

INTRODUCTION

Mathematics is compulsory from elementary through secondary school to higher education. As an exact science, mathematics plays a significant role in everyday life. Through mathematical knowledge, individuals can solve various problems in their daily activities. The relevance of mathematics becomes evident when integrated with elements of local cultural wisdom. Local wisdom contributes to cross-cultural transformation and gives rise to national cultural values. Indonesians regard local wisdom as both a philosophy and a guideline for practices across various aspects of life, including social and economic values, health, environmental management, construction, education, and more. The integration of culture into mathematics education is commonly known as ethnomathematics.

Linguistically, ethnomathematics comprises three parts: ethno, which refers to cultural elements; mathema, meaning to think, understand, know, and measure; and tics, which refers to techniques or methods (Rakhmawati et al., 2018). Ethnomathematics refers to mathematical knowledge that develops and evolves within the cultural context of a specific society. Brazilian mathematician Ubiratan D'Ambrosio first introduced ethnomathematics, asserting that mathematics exists in every culture and can be practiced by small groups or communities (D'Ambrosio, 1985).

Ethnomathematics is an approach that forms part of realistic mathematics education, in which learning activities are directly related to students' culture and daily life. This learning process encourages students to actively discover new mathematical concepts within the culture around them to solve mathematical problems (Fredi, 2016). Furthermore, (Hasanah et al., 2024) culture plays an important role in the emergence and development of mathematics learning. However, students still do not realize that mathematics is very close to students, especially in its own cultural elements.

Research conducted by (Joko et al., 2021) identified several impacts of implementing the ethnomathematics learning approach, namely: (1) ethnomathematics makes mathematics learning more enjoyable and contextual,

(2) ethnomathematics reduces students' perception that mathematics is abstract and complex, instead making it seem real and enjoyable, (3) ethnomathematics helps students better understand their own culture as well as others, and (4) ethnomathematics fosters awareness and appreciation of cultural heritage. Educators can also apply ethnomathematics through traditional music, such as the angklung.

The angklung is a traditional Indonesian musical instrument originating from the Sundanese people. It is made of bamboo and played by shaking and simultaneously tapping the bamboo frame to produce specific tones. The origin of bamboo music instruments like the angklung is rooted in the worldview of the Sundanese community in West Java, an agrarian society whose livelihood depends on rice (paré) as their staple food. This belief gave rise to the myth of Nyai Sri Pohaci, symbolizing the Rice Goddess who grants life (hirup-hurip). The Baduy people, regarded as descendants of the original Sundanese society, incorporate the angklung in rituals to commence rice planting. The angklung is created and played to invite Dewi Sri to descend to earth so that the rice crops will grow abundantly.

The development of the traditional musical instrument, angklung, has been introduced nationally in Indonesia. The growing number of schools—from kindergartens to secondary levels—offer angklung extracurricular activities demonstrates this trend. Moreover, angklung has gained international recognition, as evidenced by its inscription on UNESCO's Representative List of the Intangible Cultural Heritage of Humanity on November 16, 2010 (https://kebudayaan.kemdikbud.go.id/). Additionally, on November 16, 2022, the world's largest search engine, Google, featured the angklung on its homepage as a Google Doodle to celebrate World Angklung Day.

Several types of traditional angklung still exist in Indonesia today, particularly among the Sundanese communities in West Java and Banten. These include angklung kanekes, angklung dogdog lojor, angklung gubrag, angklung badeng, and angklung buncis (Rosyadi, 2012).

Putri (2017) conducted an ethnomathematics study. She concluded that mathematical concepts are present in musical instruments, in their shapes (curved, circular, cylindrical, and conical forms) and playing techniques (such as counting beats). In addition to the mathematical elements, the angklung embodies philosophical values as a traditional musical instrument. The multiple bamboo tubes of varying sizes—both large and small—symbolize the angklung's philosophical meaning (Hasnatuloh, 2021). This morphology reflects the view that we should protect, help each other, and practice cooperation (gotong royong). The spirit of gotong royong produces harmony through collaborative work because the philosophy of the angklung, with its differences in instruments and tones, allows us to create harmony that fosters giving and brings peace to the world.

Therefore, this study aims to investigate the philosophical values embedded in the angklung musical instrument and the ethnomathematical concepts within the angklung.

RESEARCH METHODS

This study uses a qualitative research design to gain an in-depth understanding of the phenomena under investigation (Creswell & Poth, 2018). The researchers collect data through observations, interviews, and document analysis (Moleong, 2020). They apply descriptive analysis to systematically describe the philosophical values and ethnomathematical concepts embedded in the traditional angklung musical instrument (Sugiyono, 2019). The researchers conducted the study at Az-Zaitun Kindergarten Medan, located at Jl. Garu III No.49, RT.02, Harjosari I, Medan Amplas District, Medan City, North Sumatra, 20147. The research site was selected because the school offers angklung extracurricular activities, facilitating data collection in the field.

The data analysis technique used in this study follows the Miles and Huberman model, which consists of data reduction, data display, and conclusion drawing (Holidun et al., 2018). Data reduction involves selecting, focusing, simplifying, abstracting, and transforming raw data from written field notes. Data

display refers to organizing information so that conclusions can be drawn and actions can be taken. The researcher continuously concludes that the information increases (Rijali, 2018).

RESULTS AND DISCUSSION

1. Ethnomathematics in Angklung

Ethnomathematics reveals alternative ways of engaging with mathematics by integrating school-acquired knowledge with the cultural context of its users, allowing further development (Khairunnisa & Ginting, 2022). The angklung incorporates several mathematical concepts (ethnomathematics), including geometry, similarity, combinations, and arithmetic sequences. We present the discussion of each mathematical concept as follows:

a. Geometric Concepts

Geometric concepts are present in the angklung. These include concepts related to two-dimensional (plane) and three-dimensional (solid) shapes. The two-dimensional shape found is the circle, while the three-dimensional shape is the cylinder.

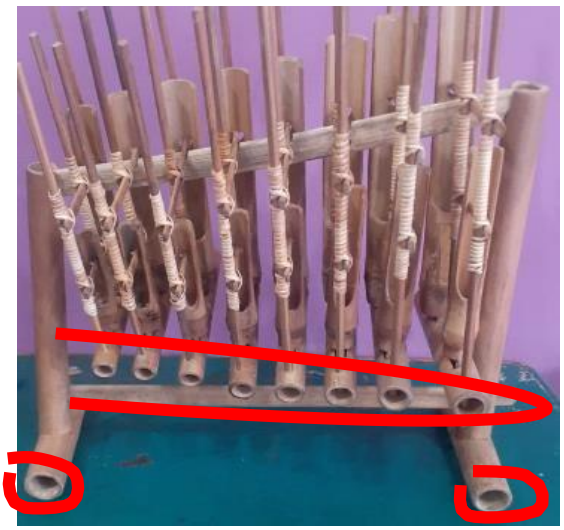

Figure 1. Geometric Concept of a Two-Dimensional Circle in the Angklung

In addition, there is also the concept of a three-dimensional shape, namely the cylinder, found in the angklung, as shown in the following figure:

Figure 2. Three-Dimensional Cylinder Concept in the Angklung

b. Concept of Similarity

The concept of similarity is present in the angklung, where the corresponding side lengths have the same ratio. For example, if the height of the first angklung bamboo tube is 20 cm and the height of the second tube is 15 cm, then the ratio between them is 4:3.

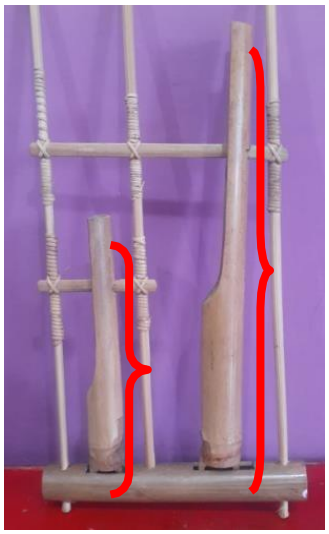

Figure 3. Concept of Similarity

c. Combination Concept

The angklung also demonstrates the concept of combination. Combination refers to a technique that describes the number of ways to arrange several objects from a group without considering the order (randomly). In angklung performances, combinations occur when players switch positions. This position exchange is done randomly (without any specific rules). Given that there are 21 students at Az-Zaitun Kindergarten Medan, while eight students play the angklung in one song, there are 203,490 possible ways to arrange the order of the angklung players.

We calculate this using the combination formula $C_8^{21} = \frac{21!}{8!(21-8)!} = 203490$. The following figure shows an example of how the eight angklung players arrange their roles.

Figure 4. Combination Concept: Arrangement Example 1

Figure 5. Combination Concept: Arrangement Example 2

Figure 6. Combination Concept: Arrangement Example 3

The findings of this study are in line with the results of previous research, which identified mathematical concepts in the angklung, including geometric shapes in both two and three dimensions, traditional measurement units, measurement equivalence of length and diameter in the angklung, as well as the concept of combinations in role exchanges during angklung performances (Hidayatulloh et al., 2018).

2. Philosophical Values in Angklung

During the extracurricular activities, students demonstrate at least six philosophical values through the angklung musical instrument: patriotism, responsibility, discipline, honesty, collaboration/teamwork, and tolerance.

a. Patriotism

Students reflect the value of patriotism when they learn about the archipelago's cultural heritage that has gained worldwide recognition. Students understand the history and development of the angklung. From this, students are encouraged to preserve the archipelago's culture, including traditional music like the angklung, which students can perform in national songs.

b. Responsibility

Students demonstrate responsibility by performing their roles in playing the angklung. Students must be accountable for the notes assigned

by the teacher. A student must be alert and attentive, especially when it is their turn to play a particular note in the song.

c. Discipline

Students also demonstrate discipline during the angklung extracurricular activities. This is evident in their readiness to play, punctuality in picking up the instruments, arranging the note sequences in the song, and perseverance in learning.

d. Honesty

Students demonstrate honesty during the angklung activities by respecting the agreed-upon roles and not trying to take over their peers' parts.

e. Collaboration/Teamwork

Students demonstrate collaboration and teamwork during angklung performances, as the instrument is played in groups rather than individually. Thus, they must learn to work together to create harmonious rhythms.

f. Tolerance

Students demonstrate tolerance through angklung performances by playing national songs from various regions across the archipelago, naturally fostering their appreciation for Indonesia's ethnic and linguistic diversity.

This finding aligns with the research conducted by (Wijayanti et al., 2022), which revealed the manifestation of character values including religiosity, discipline, responsibility, social care, environmental awareness, friendliness/communication skills, independence, and patriotism. Meanwhile, (Elsera, 2021) stated that philosophical values found in the angklung include togetherness, honesty, responsibility, self-discipline, tolerance, and patriotism, which develop the civic culture of society to preserve the outcomes of transformation based on local culture.

This study shows that the angklung, as a traditional musical instrument, not only carries rich cultural values but also contains important mathematical concepts such as geometry, similarity, and combinations, as well as philosophical

values including patriotism, responsibility, discipline, honesty, collaboration, and tolerance. The shape and construction of the angklung reflect two- and three-dimensional geometric concepts and numerical patterns, making it an effective medium for culturally based mathematics learning (Apriliana et al., 2023). In addition, the production process of the Balinese angklung involves mathematical principles, particularly geometry and optimization, demonstrating the integration of local culture and mathematical science (Wulandari et al., 2024). The angklung also effectively instills mathematical concepts such as geometry and numerical patterns while increasing students' interest in learning mathematics (Nursanti et al., 2024). Although the focus is on traditional Javanese architecture, the findings support the importance of integrating philosophical values and mathematical concepts derived from local culture into mathematics education, which aligns with the social and collaborative values found in the angklung (Zuliana et al., 2023). Overall, these findings emphasize that the angklung functions not only as a musical instrument but also as a rich medium for conveying mathematical concepts and character values rooted in the cultural philosophy of Indonesian society.

CONCLUSION

Based on the results and discussion, this study concludes that the angklung illustrates important ethnomathematical concepts such as geometry, similarity, and combinations, showing how communities naturally develop mathematical ideas within their cultural practices. Moreover, the angklung expresses philosophical values including patriotism, responsibility, discipline, honesty, collaboration, and tolerance. These findings emphasize the angklung's role as both a cultural artifact and an educational tool that fosters informal mathematics learning and character development. The study offers new insights into how educators and cultural practitioners can integrate traditional instruments into learning environments to enrich students' experiences. Researchers collected qualitative data at Az-Zaitun Kindergarten in Medan to thoroughly address the

research objectives and contribute to a deeper understanding of ethnomathematics in cultural heritage.

REFERENCES

Apriliana, Y. N., Nurfitriyanti, M., & Rahmatullah. (2023). Etnomatematika pada Bentuk Alat Musik Tradisional Angklung. *Prosiding Diskusi Panel Nasional Pendidikan Matematika*, 359–366.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (4th ed.). SAGE Publications.

D'Ambrosio, U. (1985). Ethnomatematics and its Place in the History and Pedagogy of Mathematics. *FLM Publishing Association*, 44–48.

Elsera, D. (2021). Transformasi Nilai-nilai Kearifan Lokal Pada Seni Angklung Sebagai Dasar Pengembangan Civic Culture Masyarakat. *Civic Edu: Jurnal Pendidikan Kewarganegaraan*, *4*(2), 73–74.

Fredi, G. D. (2016). Pengaruh Model Pembelajaran Reflektif dengan Pendekatan Matematika Realistik Bernuansa Keislaman terhadap Kemampuan Komunikasi Matematis Siswa. *Al-Jabar : Jurnal Pendidikan Matematika*, *7*(2), 203–210.

Hasanah, R. U., Afri, L. D., & Maysarah, S. (2024). Exploration of Ethnomathematics in Pekanbaru City Traditional Hall Building. *Jurnal Tadris Matematika (JTMT)*, *5*(2), 100–115. https://doi.org/10.47435/jtmt.v5i2.3204

Hasnatuloh, I. (2021). *Falsafah Angklung: Nilai-Nilai Kehidupan dalam Seni Bambu di Masyarakat Sunda* [Skripsi, UIN Sunan Gunung Djati Bandung]. http://digilib.uinsgd.ac.id/id/eprint/42738

Hidayatulloh, N., Hariastuti, & Rachmaniah, M. (2018). Kajian Etnomatematika Angklung Paglak Banyuwangi. *AKSIOMA Jurnal Pendidikan Matematika FKIP Univ. Muhammadiyah Metro*, *7*(3), 380–389.

Joko, S., Rohim, A., Muhammad, R., & Muhammad, A. (2021). Analisis Peran Etnomatematika dalam Pembelajaran Matematika. *ANARGYA: Jurnal Ilmiah Pendidikan Matematika*, *4*(2), 184–190.

Khairunnisa, & Ginting, S. S. B. (2022). Eksplorasi Etnomatematika pada Balai Adat Melayu. *Jurnal Pendidikan Matematika Raflesia*, *7*(1), 1–12. https://doi.org/10.33369/jpmr.v7i1.20703

Moleong, L. J. (2020). *Metodologi Penelitian Kualitatif* (Revisi). Remaja Rosdakarya.

Nursanti, Y. B., Cahyani, R. A., Regita, A. S., Ramadhani, N. D., Fikriyani, F. F., & Saputra, R. Y. (2024). Systematic Literature Review: Implementasi Etnomatematika pada Alat Musik Angklung untuk Penanaman

Konsep Geometri dan Pola Bilangan. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *8*(2), 1173–1184. https://doi.org/10.31004/cendekia.v8i2.3169

Putri, L. I. (2017). Eksplorasi Etnomatematika Kesenian Rebana Sebagai Sumber Belajar Matematika pada Jenjang MI. *Jurnal Ilmiah Pendidikan Dasar*, *4*(1), 21–31.

Rakhmawati, R., Anggoro, B. S., Indriyani, N. S., Utami, A., & Cahyanti, A. D. (2018). Ethnomathematics: Exploration of Lampung Bark Manuscript Transcription. *SSRN Electronic Journal*.

Rijali, A. (2018). Analisis Data Kualitatif. *Jurnal Alhadharah*, *17*(33), 81–95.

Rosyadi. (2012). Angklung: Dari Angklung Tradisional ke Angklung Modern. *Jurnal Patanjala*, *4*(1), 26–40.

Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D.* Alfabeta.

Wijayanti, Harubi, A., Baedowi, S., & Azizah, M. (2022). Penanaman Nilai Karakter Melalui Ekstrakurikuler Seni Musik Angklung di SDN 4 Gubug Kabupaten Grobogan. *JANACITTA : Journal of Primary and Children's Education*, *5*(1), 56–65.

Wulandari, E. M., Handayani, W. E., Kirei Saraswati, N. M. A., Dhirayani, N. K., & Made Srinadi, I. G. A. (2024). Analisis Unsur Etnomatematika dan Nilai Optimasi pada Produksi Alat Musik Angklung Bali. *Journal on Education*, *6*(3), 15973–15982. https://doi.org/10.31004/joe.v6i3.5476

Zuliana, E., Dwiningrum, S. I. A., Wijaya, A., & Purnomo, Y. W. (2023). The Geometrical Patterns and Philosophical Value of Javanese Traditional Mosque Architecture for Mathematics Learning in Primary School: An Ethnomathematic Study. *Journal of Education Culture and Society*, *14*(2), 512–532. https://doi.org/10.15503/jecs2023.2.512.532