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Summarizing Findings and Looking the Trend of the Ethnomathematical Exploration in Folk Dances

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Abstract

Folk dances are a vital aspect of cultures worldwide, passed down through generations and rich in tradition. Numerous ethnographic studies of folk dances have revealed intricate mathematical structures within these cultural practices. This meta-synthesis examines various research studies employing an ethnomathematical approach to folk dances. By synthesizing existing literature, this study uncovers the diverse mathematical concepts embedded in these dance traditions, including geometrical ideas such as lines, shapes, angles, number patterns, sequences, and fundamental operations. These mathematical concepts are evident in the movements of dancers, choreography, and hand gestures. Additionally, there is an anticipated increase in the publication of such research by the end of 2024, with Indonesia leading in the number of published ethnomathematical studies on folk dances.

Keywords: Meta-synthesis, Ethnomathematics, Folk dances

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1. Introduction

Folk dances are an important part of cultures all over the world that have been handed down through generations. It is used to express one's customs, values, and beliefs of a specific group of people or place. These dances are usually performed at social gatherings, festivals, weddings, and other occasions. Thus, folk dances are essential in social cohesion and cultural preservation making it more than just a form of entertainment or artistic expression (Blume, 2023). Hence, folk dances are naturally a source of pride that must be explored, preserved, researched, and integrated into various sectors of community life, including education.

While ethnomathematics is defined as mathematics that is practiced and developed in certain cultural group (D'Amrosio, 1985), it is also defined as a technique that can explained and understand mathematics originating from culture by exploring the mathematical concepts contained in the culture (Fredy, et.al., 2020). This research not only enriches the academic landscape but also promotes the preservation and appreciation of cultural heritage through the lens of mathematics. By exploring the ethnomathematics to cultural activities such as folk dances, teachers can engage students in a deeper understanding of mathematics through the lens of cultural practices, enhancing their learning experience and fostering a more inclusive and relevant mathematics education (Ribiero, et.al., 2020). Moreover, learning through culture can help students discuss and appreciate their own culture (Supriyadi et.al., 2020).

Several studies of folk dances with an ethnographic approach around the world were made. However, comparative research across different countries and its folk dances are often unexplored. This meta-synthesis aims to summarize different research with ethnomathematical exploration on folk dances.

2. Methods

2.1 Research Questions

This meta-synthesis hopes to answer the following questions:

1. What is the trend in the publication of ethnomathematics research within the context of folk dances, and which country leads in terms of publications in this field?
2. What elements of folk dances are inherently mathematical?

3. What mathematical concepts and procedures were derived from the ethnomathematical studies in folk dances?

2.2 Research Design

This is a meta-synthesis conducted to summarize and synthesize the findings of research on the exploration of ethnomathematics in folk dances. The concept of meta-synthesis refers to the process of integrating findings from multiple qualitative studies to generate new insights and broader understandings (Walsh and Downe, 2005).

2.2.1 Inclusion and Exclusion Criteria

The included studies were screened according to the following inclusion criteria: (1) focused on ethnomathematics within the context of folk dances; (2) must include studies of exploration of mathematical concepts; (3) must utilized qualitative research design with ethnomathematical approach; and (4) published in English and published in scientific journals from 2015 to April 2024.

2.2.2 Search Strategies

To access the studies, the Google Scholar web search engine was reviewed by utilizing the keywords 'ethnomathematics', 'folk dances' and 'traditional dance.' This meta-synthesis adheres to the Preferred Reporting for Systematic Review and Meta-Analyses (PRISMA) standard to comprehensively gather existing literature on ethnomathematics on folk dances in different countries (Paige, et.al., 2021).

Identification. The search resulted in 330 articles which were obtained last April 15, 2024 on Google Scholar.

Screening. A total of 330 articles were manually screened. The screening revealed that 4 articles were published outside the year range 2015–2024, 15 lacked abstracts, 8 were duplicates, and 4 were not written in English. Next, the remaining articles were screened using the inclusion criteria. There were 122 studies which were not ethnomathematics. Then, 112 of the remaining articles are not exploration of ethnomathematical concepts. After the screening, 65 studies were left.

Eligibility. 33 articles were excluded because it was found to be qualitative research with ethnomathematical exploration on other components of culture, such traditional games, clothing, craftmanship and architecture. As a result, 32 articles were included for the meta-synthesis (see Figure 1).

2.2.3 Data Analysis

The emerging themes were identified using the thematic analysis method outlined by Clarke and Braun (2013). The steps in this thematic analysis include: (1) familiarizing oneself with the data, (2) generating initial codes, (3) searching for topics, (4) reviewing themes, (5) defining and naming themes, and (6) interpreting the results.

3. Results and Discussion

There are 32 studies selected for inclusion which spread out to 6 different countries.

3.1 The Publication Trend

The number of published ethnomathematics studies about folk dances has significantly increased during the years 2017 to 2021. After this, there is a decreasing trend from 2020 to 2023. The data used in this study was collected April 2024. It was expected that there will still be published studies for the remaining 8 months and will have an increased in publication by the end of 2024. (See Figure 2)

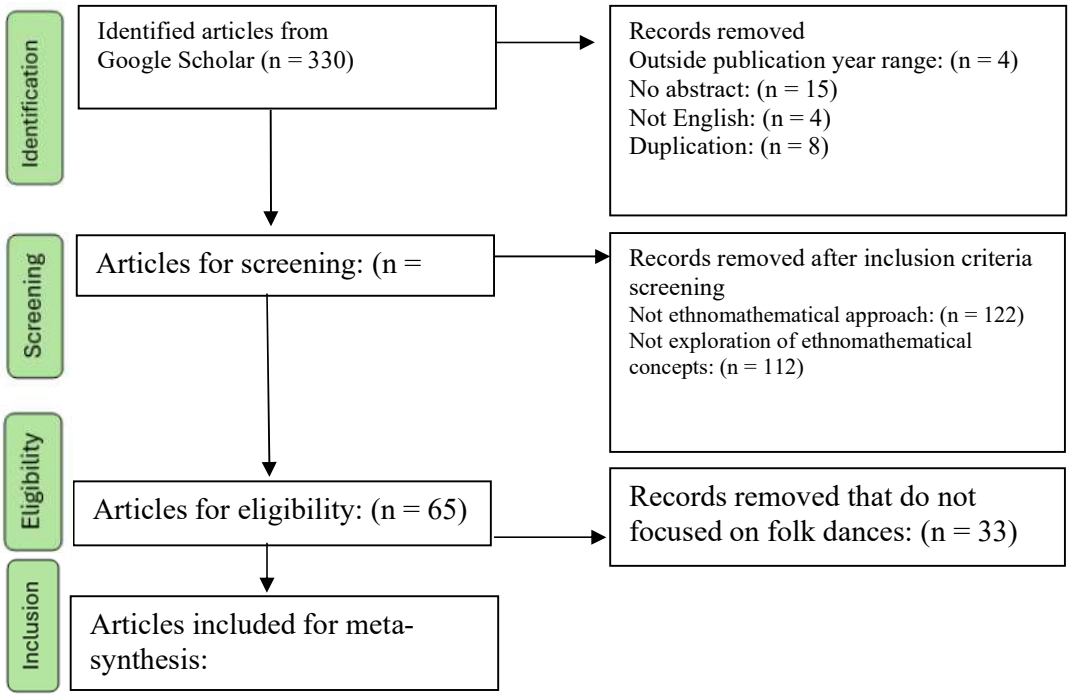

Figure 1: Flow Chart for Study Selection Process

The flow chart shows the process of selecting articles for meta-synthesis.

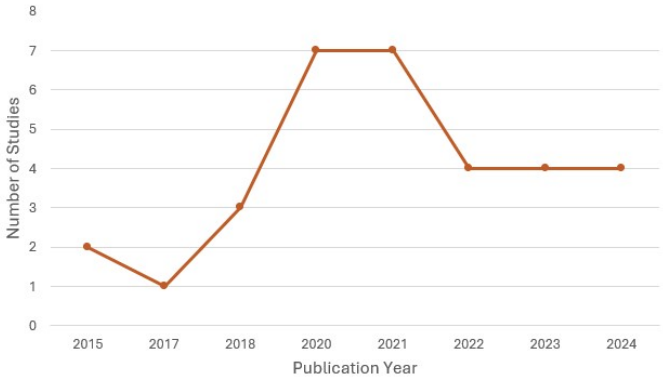

Figure 2: The trend of ethnomathematical studies on folk dances in 2015 - 2024

Figure 2 depicts research publications on the exploration of ethnomathematics in folk dances from 2015 to April 2024.

3.2 Top Country Contributor

Figure 3 depicts the countries which have made significant contributions to the study of exploration of ethnomathematics in folk dances. The extensive focus on ethnomathematics in Indonesian folk dances is clearly shown, having the highest number of studies in the exploration of ethnomathematics related to folk dances. (See Figure 3)

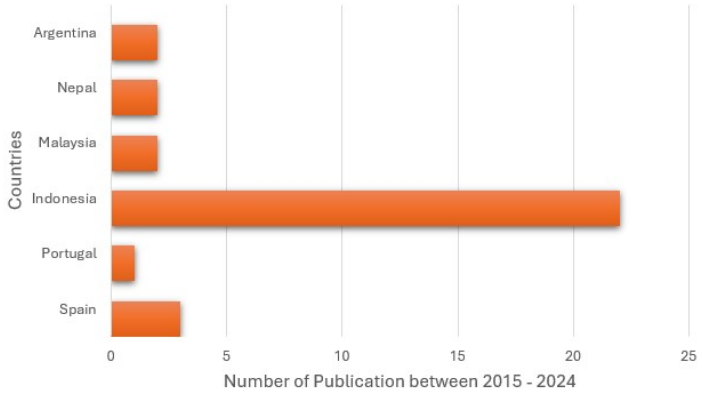

Figure 3: Countries and its number of ethnomathematical studies on folk dances

The figure highlights the countries that have focused on and given attention to the ethnomathematical exploration of folk dances.

3.3 The Elements of Dance

Dance is made up of 5 main elements: body, action, time, energy, and space. Specifically, these elements include body movement of the different parts of the dancers' body; actions like hand gestures, facial expressions, leaping, running, walking and twirling; space such as backward, forward, curved or straight, time and energy in dancing such as moving gracefully or heavily. (Wanek, 2015)

The study also aims to investigate the elements of dance where presence of mathematical concepts was found.

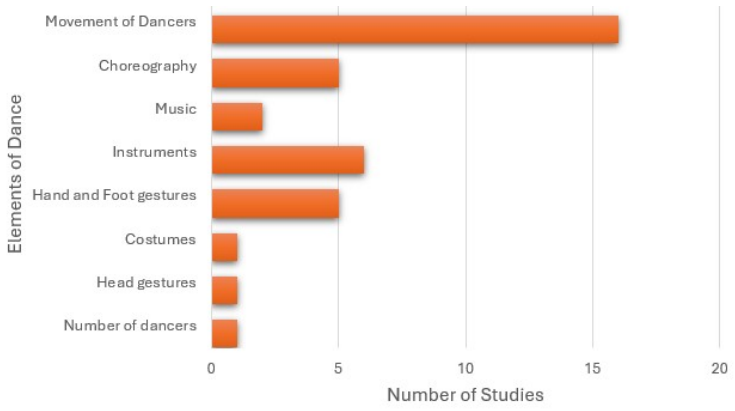

Figure 4: Elements of Dance with inherent mathematical concepts

The figure illustrates the most and least intrinsic mathematical concepts found in folk dances.

Figure 4 tells that mathematics can still play a significant role in various elements of folk dance. The figure shows that 16 out of 32 studies highlighted the mathematical properties of the dancers' movements. Followed by instruments which has 5 ethnomathematical exploration studies. Also, choreography and hand and foot gestures explicitly demonstrate mathematical concepts in both 5 out of 32 studies. 2 studies explore the music element of

folk dance while 1 study each for number of dancers, head gestures and costumes.

3.4 Mathematical Concepts in Folk Dances

Table 1 presents the outcomes of the mathematical concepts identified in the studies. The mathematical concepts of circle and circumference stands out as having the greatest frequency of occurrence with 10 out of 32 studies. The second prevalent mathematical concept is the concept of angles with 8 out of 24 studies. Lines and quadrilaterals, such as squares, rhombus and rectangles follow which were embedded in 7 out of 32 studies on ethnomathematics on folk dances. While concepts of probability, functions, fundamental operations, number patterns, fractions and logic have appeared in the included research, geometry is certainly the common focus of the 32 included studies on exploration of ethnomathematics in folk dances.

Table 1: Mathematical Concepts found on Elements of Folk Dances

Mathematical Concepts	Number of Studies
Circumference/Circles	10
Square, Rhombus, Rectangle	7
Angle (acute, right, obtuse, vertical, opposite)	8
Triangles	4
Lines (Straight, Parallel, Perpendicular)	7
3D shapes (Cone, cylinder, sphere)	5
Geometric Transformation	4
Symmetry	2
Operations (Addition, Multiplication)	3
Mathematical Logic	2
Sequence	1
Relations and Functions	1
Graphs	1
Permutation	1
Fractions	1
Distance	1

The table above demonstrates the various mathematical concepts embedded in the elements of folk dances.

3.5 Integration of Ethnomathematics and Elements of Folk Dances

This section describes the integration of ethnomathematics in folk dances. The following themes under this category were discussed:

Theme 1: Geometric Concepts on Dance Movements

Several studies highlight the presence of various geometric shapes and angles in dance movements. For instance, the Pendet dance incorporates acute, right, and obtuse angles through hand gestures (Radiusman, et.al., 2021). Similarly, the Lahbako dance movements illustrate lines, acute and obtuse angles, and various geometric fields like triangles and rectangles (Putra, et.al, 2023). Also, Ghetak Pamekasan Mask Dance highlights angular geometry in the dance movements, providing a means to introduce mathematical concepts through local cultural practices (Sepriani and Zayyadi, 2023). The Zapin Dance also explores the geometry produced by repeated foot movements in the traditional Malay dance (wan Muhammad, et.al, 2018). The study on Reog Kendang Dance identifies geometric concepts including circles, triangles, curved side spaces, volume of rotating objects, and symmetry in the dance movements (Fitriyah, 2022).

Theme 2: Mathematical Concepts in Musical Context

Mathematics can be seen in the musical context of folk dances in various ways, primarily through the structure and patterns in rhythms, beats, and musical compositions. The beats and rhythms in folk dances often relate to fractions and numerical patterns. For instance, Newari culture uses fractions to write musical beats (1/4, 1/2, 1/3, 6/8) (Maharjan and Suwal, 2017). In addition, musical instruments like those in the Gamelan Reyog Ponorogo can be used to teach concepts of sets and numbers (Kurniawati, 2021). In Maneo de Verdillo Dance, music adheres to geometric transformations, such as translation and rotation, mirroring the dancers' movements and illustrating mathematical symmetry and patterns in the music (Ribiero, et.al., 2022). Similarly, the Caci dance includes rhythmic sequences that correlate with counting and arithmetic progressions, where the beats and steps are calculated to create harmonious patterns (Dominikus, et.al., 2024)

Theme 3: Mathematical Transformations in Choreographic movements

Mathematical transformations in choreographic movements are evident in several ethnomathematical studies of folk dances. For example, Beskalan Putri Malang Dance inherent mathematical concepts present in the dancers arrangement, focusing on geometric transformations such as translation, rotation, reflection, dilation, and composition of transformations (Moh, et,al., 2021). Moreover, the choreography of the Maneo de Verdillo dance was revealing geometric shapes and transformations within the dance movements (Ribiero, et.al., 2022)

3.6 Cultural Relevance and Educational Integration

This section describes the integration of ethnomathematics concepts found in folk dances in the teaching-learning process. The integration of ethnomathematics concepts found in folk dances into the teaching-learning process provides a holistic educational approach that respects and utilizes cultural heritage. It creates a more engaging and meaningful learning experience by connecting abstract mathematical concepts with tangible cultural practices. The following themes under this category were discussed:

Theme 1: Contextual Learning through Meaningful Activities

Ethnomathematics integrates mathematical concepts with cultural contexts, making learning more relatable and engaging for students. For instance, the Kejei dance in Indonesia helps students understand geometry through familiar cultural practices. By identifying and creating projections of flat shapes within the dance, students learn geometric concepts in a culturally relevant manner (Ma'rifah, et.al., 2018). The pattern in Legong dancer position can be used to create meaningful ethnomathematics-based geometry problems for seventh grade students. This will enhance students learning experience in logic and reasoning (Wijayanti, et.al., 2018). The finding in the study of Beskalan Putri Malang Dance can be a source of contextual mathematics learning on geometric transformations for high school students (Susanti, et.al, 2021)

Theme 2: Fostering community cohesion and promotes inclusivity.

Incorporating ethnomathematics into education promotes inclusivity by valuing and representing diverse cultural practices in the curriculum. The exploration of geometric shapes in the Rapa'i Geleng dance, for instance, highlights the representation of local cultural practices in mathematical education (Musawwir, et.al., 2021). In addition, folk dances provide a sense of belonging and pride among community members, helping to maintain and reinforce cultural values and traditions. The Jai dance, for example, not only embodies geometric shapes and forms but also reinforces the cultural identity of the community that practices it (Bito and Fredy, 2020).

Theme 3: Interdisciplinary Learning and Self-Efficacy

Ethnomathematics and folk dances offer an interdisciplinary approach to learning, bridging mathematics with cultural studies, history, and the arts. This interdisciplinary approach enriches the educational experience by providing a well-rounded understanding of how different fields are interconnected. The Gamelan Reyog Ponorogo study highlights the use of musical instruments to teach mathematical concepts, illustrating the intersection of music, mathematics, and cultural studies (Kurniawati, et.al., 2021). Moreover, by learning through culturally relevant practices, students can develop a stronger sense of self-efficacy and empowerment. They gain confidence in their ability to learn and apply mathematical concepts within the context of their cultural heritage. The Lahbako dance, which teaches mathematical literacy through dance movements, helps students feel more connected to their culture and more confident in their mathematical abilities (Putra, et.al., 2023).

4. Conclusion

Some people might view Mathematics as disconnected from daily life or human existence, but this perception overlooks its profound influence across cultures. This study recognized mathematics which is deeply ingrained

in traditional dances all over the world and underpins many aspects of the lives of our ancestors a long time ago. There are mathematical principles that manifest in the intricate elements of folk dance such as in choreography, dance movements, and hand and foot gestures. Through ethnomathematics, learning mathematical concepts such as angles, lines, and quadrilaterals, through folk dances can indeed evoke a sense of wonder and appreciation of the culture, of the subject and even of human existence.

5. Recommendations

The following recommendations are made to enhance the integration of mathematical concepts found in folk dances into the educational process, thereby providing meaningful learning experiences for learners: (1) design lesson plans that explicitly incorporate the mathematical concepts identified in various folk dances; (2) create engaging and interactive activities that allow students to explore mathematical concepts through dance elements; and (3) develop multimedia resources such as instructional videos, interactive tutorials, and digital dance simulations that demonstrate the connection between dance and mathematics. Furthermore, it is recommended to study on the underlying reasons and factors for a significant exploration of mathematical concepts within the diverse folk dances of the Philippines, a country rich in cultural diversity.

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