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The Role of Visual Metaphors in Ethnomathematics to Strengthening Mathematical Literacy

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ABSTRACT

Introduction. The uniqueness of this study lies in the innovative approach to mathematics education that integrates ethnomathematics with visual metaphors. Employing visual metaphors facilitates the shift from mathematical understanding to theoretical concepts and their practical use in daily life. This study investigates the effectiveness of ethnomathematics learning innovations utilizing visual metaphors to enhance mathematical literacy and reinforce Pancasila values among elementary school students.

Study participants and methods. The research methodology employs an exploratory sequential mixed-method approach. The study began with a qualitative phase aimed at exploring the role of visual metaphors in representing the emotions, beliefs, and experiences of teachers and students within the context of ethnomathematics education. Insights from this qualitative phase were used to design and develop innovations in ethnomathematics learning through visual metaphors. Subsequently, a quantitative phase was conducted using an experimental method to evaluate the effectiveness of ethnomathematics learning with visual metaphors in improving mathematical literacy and Pancasila values. The quantitative stage involved 108 participants, consisting of 54 students in the experimental group and 54 students in the control group drawn from elementary schools in Yogyakarta. Data were analyzed using descriptive statistics and independent samples t-test.

Results. The findings indicate that the independent-sample t-test for mathematical literacy reveals an average score of 0.689 for the experimental class, compared to an average of 0.294 for the control class. This suggests a significant difference, with the experimental class demonstrating a notably higher average in mathematical literacy ($p = 0.000 < 0.05$). The independent-sample t-test results for the Pancasila Student Profile indicated an average of 0.703 for the treatment class and 0.431 for the control class. This suggests that the average Pancasila values of the treatment class is significantly greater than that of the control class ($p = 0.000 < 0.05$). These results highlight the effectiveness of the proposed ethnomathematics learning model integrating visual metaphors, which emphasizes contextual cultural representation, emotional engagement, and reflective interpretation of mathematical ideas through culturally embedded symbols and imagery. The model facilitates deeper conceptual understanding, enhances students' mathematical literacy, and strengthens internalization of Pancasila values through culturally meaningful and emotionally resonant learning experiences.

Conclusion. The conclusion of the research indicated a significant enhancement in students' mathematical literacy skills following the implementation of ethnomathematics learning utilizing visual metaphors. The increase in mathematical literacy test scores demonstrates the ability to formulate mathematical problems from everyday situations. This educational innovation positively influences the enhancement of Pancasila students' profiles, particularly in the areas of critical and creative reasoning. The findings of this study suggest that the ethnomathematics learning model utilizing visual metaphors should be widely socialized and implemented in elementary schools.

KEYWORDS

learning innovation; ethnomathematics; visual metaphor; mathematical literacy, Pancasila values

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INTRODUCTION

In alignment with international educational initiatives led by organizations such as UNESCO, the Council of Europe, and the United Nations International Association (UIA), the development of mathematical literacy has been recognized as a key component in achieving Education for Sustainable Development (ESD) and promoting global citizenship education (GCED) [1]. Mathematical literacy serves as a foundational competence enabling individuals to make informed decisions, solve real-world problems, and participate meaningfully in social and economic life. It refers to the capacity to comprehend and utilize mathematics across diverse real-life situations [2]. Students equipped with mathematical literacy skills can grasp the connections between pertinent mathematical concepts and subsequently apply them to address problems [3]. These skills are essential for students, particularly given the intense competition of the 21st century. Regrettably, the mathematical literacy skills among students in Indonesia remain quite limited. The ranking from the Program for International Student Assessment (PISA) in 2022 highlights this low ability, as Indonesia placed 68th with a math score of 379 [4].

Mathematics is characterized as an abstract discipline that explores the science of numbers and spatial relationships [5]. Metaphors serve as a means to grasp abstract and intricate phenomena [6] functioning as a cognitive instrument that facilitates the acquisition of the unfamiliar, aids in the retention of previously learned information, and enables recall when needed [7]. The application of visual metaphors has garnered increasing attention in recent years [8; 9]. Metaphors enhance the learning process by incorporating storytelling, vivid imagery, and imaginative contexts linked to them [10]. The integration of visualization and metaphor is essential for grasping the process of meaning-making and comprehension [11]. Visual metaphors have the potential to enhance the process of teaching and learning in mathematics. The possibility of visualizing this material may foster a new approach to teaching that challenges the perception of math education as intimidating for students. Employing visual metaphors in mathematics education can significantly enhance a student's learning experience [12].

The significance of metaphorical thinking facilitates the shift from mathematical understanding to theoretical frameworks and their practical use in daily life. Numerous educators and learners in mathematics often encounter challenges when attempting to conceptualize mathematical entities within practical contexts [13]. These mathematical constructs may not have a physical presence in reality, yet we can create representations using materials such as soil, metal, wood, plastic, and others. A circle can be exemplified by a metal ring. Mathematical metaphors present in everyday life can be effectively chosen and employed to clarify mathematical concepts with ease.

The application of metaphors in mathematics instruction fosters a connection with the concepts involved by offering explanations that are accessible and comprehensible in a brief timeframe. Metaphor learning involves the transformation of abstract mathematical concepts into tangible forms through activities that link these concepts with familiar materials from everyday life [14]. Metaphors are expressions rich in cultural significance, with the comprehension of a specific metaphor shaped by cultural knowledge [15]. The mathematical knowledge articulated within the language code of a specific sociocultural group is referred to as "ethnomathematics" [16]. Mathematics created by experts in the field can also be viewed as a type of ethnomathematics, as it originates from a specific cultural group.

Ethnomathematics refers to the methods employed by individuals within a specific culture to navigate and understand quantitative, relational, and spatial dimensions of their existence. Mathematics emerges as a cultural artifact shaped by diverse activities, where counting, finding, measuring, designing, playing, and explaining contribute to this cultural construct [17]. Ethnomathematics represents a culturally grounded approach to understanding mathematics [18]. The study of ethnomathematics offers extensive and profound avenues for exploration. This research examined the ethnomathematics inherent in Javanese culture. This study examines Javanese Culture through the lens of building architecture, cuisine, and traditional games, utilizing geometric concepts to analyze both two-dimensional structures, referred to as flat buildings, and three-dimensional forms, known as spatial buildings. The incorporation of cultural artifacts and tangible materials into mathematics education facilitates the process of knowledge construction [15]. In Javanese culture, ethnomathematics manifests through cultural and non-cultural structures, traditional cuisine, and batik patterns that are connected to mathematical ideas, offering opportunities for integration into educational practices [19]. Indigenous peoples employ symbolic measuring tools in their everyday practices, highlighting the significance of ethnomathematics in their lives [20].

In this context, [21] describe ethnomodelling as the convergence of cultural anthropology, ethnomathematics, and mathematical modeling (Figure 1). The ethnomodelling process highlights the connection between mathematical modeling and ethnomathematics, emphasizing the importance of respecting and valuing the tacit knowledge gained by members of various cultural groups. This knowledge allows us to access, translate, and evaluate the problem situations encountered daily as we develop ethnomodels in diverse contexts.

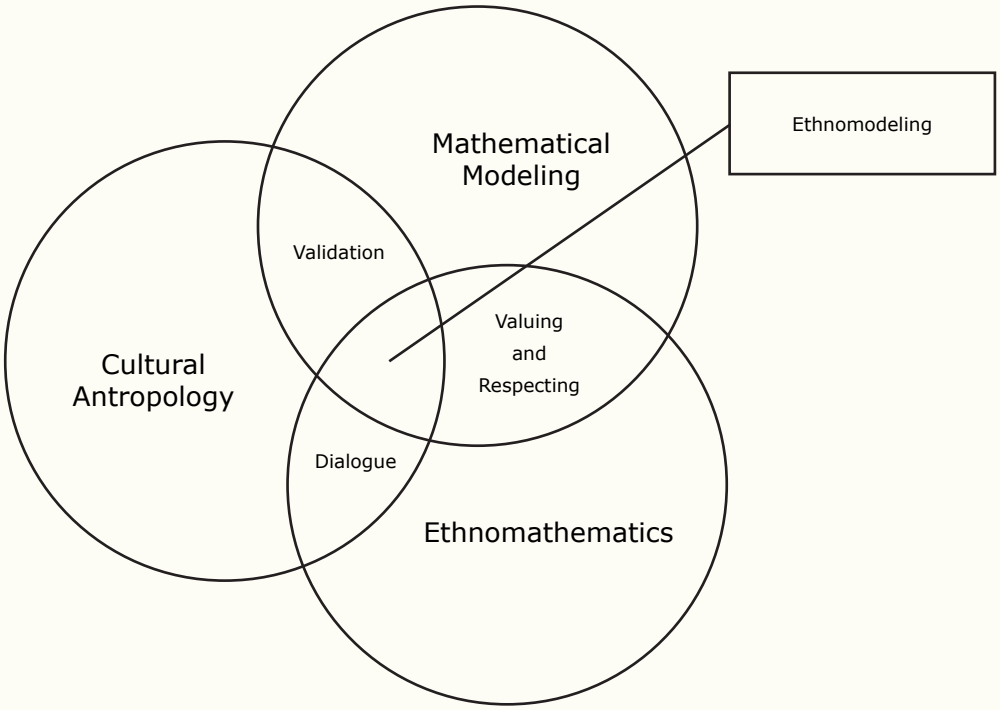

Figure 1 Ethnomodelling

Enhancing the application of ethnomathematics in alignment with the cultural diversity of learners and the integration of mathematics into their everyday experiences [22]. Such an approach aims to make mathematics more accessible, meaningful, and contextually relevant to students [22]. The instruction of mathematics via ethnomathematics equips students to thrive in a society that values cultural dignity, fosters critical thinking regarding social justice, and cultivates an understanding of their roles and responsibilities in civic engagement [23; 24]. Ethnomathematics in learning activities should serve as a means to foster solidarity and cooperation among students [25]. Javanese culture offers noble values that serve as a foundation for universal character education [26]. This study explores the significance of integrating cultural mathematics into educational practices, aiming to enhance students' character development in alignment with the Pancasila Student Profile through innovative visual metaphors.

Prior investigations indicate that the incorporation of ethnomathematical methods [27] in Mathematics learning holds significant importance as it is thought to enhance students' comprehension and performance in the subject [28; 29]. Students instructed through an ethnomathematical approach demonstrate superior performance when compared to those taught using traditional methods [30]. Hautopp explored how humor and visual metaphors can foster engagement and meaning-making in visual facilitation, emphasizing the emotional and cultural dimensions of visual expression in learning [31]; Yıldız examined pre-service science teachers' self-efficacy within the framework of Technological Pedagogical Content Knowledge (TPACK), demonstrating that visual metaphors strengthen reflective thinking and conceptual integration in teacher education [32]; Meanwhile, Aidah, Sobarningsih, and Rahayu investigated metaphorical thinking supported by digital tools, finding that visual metaphors enhance students' mathematical understanding and creativity in representing abstract ideas [33]. There is a necessity to enhance innovations in ethnomathematics learning to boost mathematical literacy and the profiles of Pancasila students [34].

The uniqueness of this study lies in the innovative approach to mathematics education that integrates ethnomathematics with visual metaphors. Employing visual metaphors facilitates the shift from mathematical understanding to theoretical concepts and their practical use in daily life. Cultural-based learning through ethnomathematics effectively connects mathematics to students' everyday experiences. The quantitative approach predominates in both methods concerning ethnomathematics and visual metaphors. This investigation employs an exploratory sequential mixed method to generate a thorough evidence-based practice. Third, a gap remains in the existing literature that links ethnomathematics with visual metaphors.

An investigative emphasis on the ways educators and learners conceptualize interactions involving ethnomathematical resources and visual metaphors as crucial components in enhancing mathematical literacy and Pancasila student profiles. What is the effectiveness of using visual metaphors in ethnomathematics learning for enhancing mathematical literacy and the Pancasila values?

RESEARCH METHODS

1. Materials and Methods

The methodology employed was an exploratory sequential mixed-method approach [35]. The study commenced with a qualitative approach aimed at examining the role of visual metaphors in conveying the emotions, beliefs, and experiences of educators and learners within the context of ethnomathematics education. The data collection involved conducting interviews with a group of 10 elementary school teachers in Yogyakarta Province, specifically those who teach mathematics to Grade 5 students. During the fifth grade, an exploration of flat building materials and space building materials was conducted, which proved to be highly relevant for ethnomathematics through the use of visual metaphors. Subsequently, a focus group discussion was conducted with elementary school teachers in Yogyakarta Province to validate the insights gathered from interviews with experts in ethnomathematics.

2. Participants and data collection

The findings from qualitative studies informed the development of innovative ethnomathematics learning approaches utilizing visual metaphors. The development of teaching modules for ethnomathematics utilizing visual metaphors is currently underway. The teaching module will be structured in alignment with the Independent Teaching Platform, which includes: 1) General information (selection of unit type and educational level, phases and classes, subjects, title, general description, module authors' identity, and cover image); 2) Module objectives (usage design, total lesson hours allocation, learning mode determination, target student demographics, student count, facilities and infrastructure, competency prerequisites); 3) Materials, assessments, and references.

Additionally, an experimental method was employed in quantitative research to assess the effectiveness of ethnomathematics learning utilizing visual metaphors in enhancing mathematical literacy and Pancasila student profiles. The experimental study employs a True Experimental Design featuring a Pretest-Posttest Control Group Design. This design involves the random selection of two groups, followed by a pretest to determine any differences between the experimental group and the control group.

The subject of the study was a 5th-grade elementary school student in Yogyakarta Province. The research involved two public schools and two private schools in Yogyakarta Province; each school was carried out in two study groups that would be randomly selected as the experiment/control group. The method of gathering data involves utilizing assessment tools and surveys. This tool is utilized in both the pre-test and post-test phases. The assessment tool is designed to evaluate students' mathematical literacy, whereas the survey aims to assess the Pancasila values.

3. Research tools

Mathematical literacy encompasses the capacity of students to represent problems, apply mathematical knowledge to solve them, construct arguments, and interpret and convey solutions

to real-life mathematical challenges. The assessment tool is employed to evaluate students' mathematical literacy using the subsequent framework [36].

Table 1 Mathematics Literacy Test Grid

Indicator	Question Number
Formulate a situation in a mathematical form or model using appropriate representations	1, 2, 3,4, 5
Using mathematical concepts, facts, and procedures to solve everyday problems	6, 7, 8, 9,10
Interpreting and communicating the results or solutions of mathematical problems	11, 12, 13, 14, 15
Make arguments based on mathematical information or Mathematical Problem Solutions	16, 17, 18, 19, 20

The Pancasila values encompass the character traits and competencies that students are anticipated to develop, grounded in the esteemed values of Pancasila. This study emphasizes the indicators of critical and creative reasoning within the Pancasila values framework [37].

Table 2 Pancasila Values Questionnaire Grid

Indicator	Question Number
Critical reasoning	1, 2, 3,4, 5
Creative	6, 7, 8, 9,10

4. Data analysis

Prior to its application as a research tool, the test instrument underwent a series of evaluations including validity testing, reliability testing, difficulty assessment, and differentiation analysis. The questionnaire instrument underwent testing to confirm its validity and reliability levels. The data collected from the experimental study was subsequently subjected to statistical analysis. The data was collected from the pre-test conducted before the learning phase and the final test (post-test) administered following the completion of the learning process. Once the pre-test and post-test results are gathered from the scoring outcomes, the average improvement in student learning outcomes will be determined through the calculation of N-Gain. Additionally, an independent sample t-test was conducted to assess the average difference between the experimental group and the control group. The effectiveness of ethnomathematics learning utilizing visual metaphors was assessed in terms of its impact on enhancing mathematical literacy and Pancasila student profiles through the calculation of the effectiveness ratio (RE).

STUDY RESULTS

This study commenced with the teaching modules and learning modules, achieved by gathering insights from resource individuals via Focus Group Discussions (FGD). The Focus Group Discussion comprised one expert in ethnomathematics, one lecturer in mathematics education, and 10 mathematics teachers from elementary school grade 5. This focus group discussion aims to investigate the possibilities of utilizing traditional Javanese cuisine as a visual metaphor for teaching geometry to fifth-grade elementary students. By visualizing familiar foods, the aim is to facilitate students' comprehension of the abstract concept of geometry.

This focus group discussion aims to identify a range of traditional Javanese dishes that could serve as visual metaphors for geometry concepts in fifth-grade elementary education. 2) Develop concepts and strategies to create ethnomathematics teaching modules utilizing visual metaphors from traditional Javanese cuisine; 3) Gather feedback and recommendations from various stakeholders to enhance the

teaching module. Participants in the focus group discussion highlighted various traditional Javanese culinary delights that could serve as visual metaphors for geometry concepts, including *Gethuk/ wajik:* which elucidates the idea of foundational components. *Onde-onde/klepon:* elucidates the concept of spherical shapes. *Kue lapis:* elucidates the principles of block shapes and layers within the realm of geometry. *Serabi:* elucidates the concept of circular shapes and their connection to radius and diameter. *Clorot:* elucidates the principles of tubular and conical forms. *Tumpeng:* elucidates the principles of cone and truncated cone geometries. *Kue putu/lumpia*: elucidates the idea of constructing a tube space.

Participants in the focus group discussion offered various suggestions for creating teaching modules, such as incorporating numerous engaging and vibrant images of traditional Javanese cuisine. 2) Provide specific instances of how geometry concepts are utilized in the production and presentation of traditional Javanese cuisine. 3) Offer students a diverse range of worksheets, including games, simulations, and straightforward projects that involve crafting food creations using geometric shapes. 4) Employing educational videos, animations, or interactive learning tools centered around traditional Javanese culinary themes. 5) Incorporate the 4C elements into educational activities.

Students anticipate engaging in teaching modules that are dynamic and incorporate hands-on activities with food. Educators seek instructional modules that are straightforward to implement in the classroom, accompanied by comprehensive guides for facilitators, and that encourage involvement from parents. Educators highlight the significance of precise mathematical concepts, the relevance of cultural context, and the integration of local wisdom values in instructional modules. This focus group discussion effectively identified a range of traditional Javanese culinary dishes that could serve as visual metaphors for geometry concepts in fifth-grade elementary education. The suggestions provided by the FGD participants to the teaching module development team indicate a need for additional studies on traditional Javanese culinary practices that have been identified, to ascertain the most suitable and effective visual metaphor. Teaching modules must be crafted with careful consideration of the insights and recommendations provided by FGD participants, while also aligning with the relevant curriculum. It is essential to assess and analyze the teaching modules that have been created to ascertain their efficacy and practicality before broader application.

Figure 2 Learning in the Treatment Group

Additionally, an experimental method was employed in quantitative research to evaluate the effectiveness of visual metaphor-based ethnomathematics learning in enhancing mathematical literacy and Pancasila values. A quantitative study was conducted at SD Negeri Candisari Sleman, SD Negeri Candirejo Sleman, and SD Negeri Ngringin Sleman, focusing on grade 5 students, as illustrated in Figure 2. In the meantime, the control class group consists of SD Negeri Jatisawit and SD Negeri Godean 1. The experimental class group consisted of 12 students from SD Negeri Candisari Sleman, 30 students from SD Negeri Candirejo Sleman, and 12 students from SD Negeri Ngringin Sleman. At the same time, the control class group comprised 28 students from SD Negeri Jatisawi and 26 students from SD Negeri Godean 1. The participants in the treatment group engaged with the ethnomathematics learning method, which utilized visual metaphors for mathematics instruction, whereas the control group followed a traditional lecture approach. This study employs the Problem-Based Learning (PBL) model for ethnomathematics learning through visual metaphors.

The findings from the experimental study yielded mathematical literacy scores and Pancasila student profiles, as illustrated in Figure 3 below. The analysis of the data revealed that the mathematical literacy score in the experimental class was 50.83 during the pre-test, which increased significantly to 84.17 at the post-test. Conversely, the control class exhibited a pre-test math

literacy score of 50.18, which rose to 65.46 in the post-test. This analysis reveals a distinction in the enhancement of mathematical literacy between the experimental group and the control group.

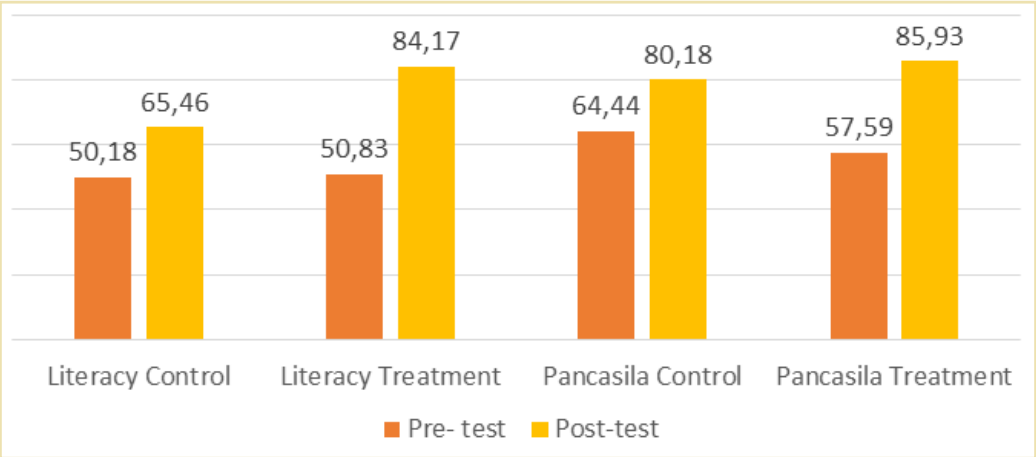

Figure 3 Scores in mathematics literacy and profiles of students reflecting Pancasila values

The analysis of the data revealed that the profile score of Pancasila students in the experimental class was 57.59 during the pre-test, which then saw a significant increase to 85.93 in the post-test. Conversely, in the control class, the profile score of Pancasila students was recorded at 64.44 during the pre-test, which rose to 80.18 in the post-test. The findings suggest a disparity in the degree of enhancement observed between the treatment group and the control group.

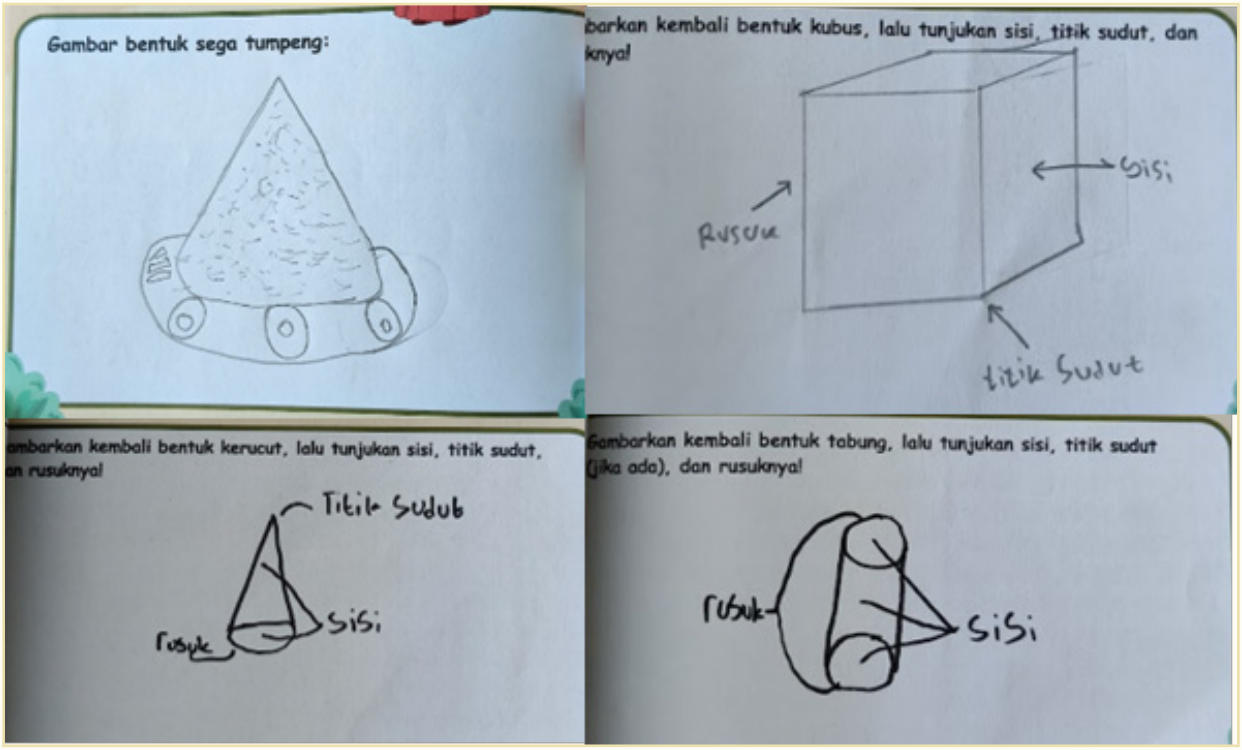

Figure 4 Visual Metaphor of Student Work

Figure 4 illustrates the outcomes of the students' work stemming from the learning of ethnomathematics through visual metaphors. Once the pre-test and post-test results are gathered from the scoring outcomes, the average improvement in student learning outcomes will be compared with the N-Gain score calculations. An independent-sample t-test was conducted to analyze the

N-Gain score from mathematical literacy and Pancasila student profiles. Table 1 below presents the summary of the analysis conducted using the independent-sample t-test comparing the treatment group to the control group.

Table 3 Findings from an independent-sample t-test comparing the treatment group to the control group

Variable	Group	Average N-Gain	t statistic	P-value
Mathematical literacy	Experimental Classes	0.689	10.869	0.000
	Control Classes	0.294		
Pancasila value	Experimental Classes	0.703	6.296	0.000
	Control Classes	0.431		

The findings presented in Table 3 indicate that the independent-sample t-test for mathematical literacy reveals an average score of 0.689 for the experimental class, compared to an average of 0.294 for the control class. This suggests a significant difference, with the experimental class demonstrating a notably higher average in mathematical literacy ($p = 0.000 < 0.05$). The independent-sample t-test results for the Pancasila Student Profile indicated an average of 0.703 for the treatment class and 0.431 for the control class. This suggests that the average Pancasila values of the treatment class is significantly greater than that of the control class ($p = 0.000 < 0.05$).

DISCUSSION

The incorporation of cultural context into mathematics education through ethnomathematical learning greatly enhances mathematical literacy. Integrating mathematics within the context of local culture enhances its relevance and engagement for students [38]. This study aligns with the findings of [39] which demonstrate that ethnomathematics enhances the accessibility of mathematical concepts by connecting them to everyday cultural practices. Ethnomathematics learning employs tangible, real-world examples to enhance the relatability and practicality of mathematics [40].

The implementation of Problem-Based Learning (PBL) within an ethnomathematical framework enables students to tackle real-world challenges through the use of mathematical concepts. This approach has demonstrated an enhancement in students' engagement and comprehension of mathematics [41]. Students will enhance their problem-solving abilities by engaging with culturally relevant examples and practices [42]. Ethnomathematics enhances cognitive abilities through context-rich problems that demand logical reasoning and effective problem-solving skills. This study demonstrates that students exposed to ethnomathematics-based learning materials exhibit a greater level of mathematical understanding than those instructed through conventional methods, aligning with the findings of the research [43].

Educators who integrate ethnomathematics into their teaching practices can foster a more just and culturally attuned educational atmosphere. This method not only alleviates math anxiety but also cultivates an environment of success and enhanced math literacy [44]. Ethnomathematics enhances mathematical literacy by connecting mathematics to cultural contexts, making it engaging and relevant to real-world issues, which in turn boosts student involvement [45]. The approach of integrating ethnomathematics in education fosters an inclusive atmosphere that honors and incorporates various cultural backgrounds, potentially resulting in improved educational results [46].

This study has achieved the development of educational resources that integrate ethnomathematics within problem-based learning contexts. This innovation has demonstrated an increase in student involvement and achievement in mathematics, aligning with the findings of the study [47]. Integrating traditional forms of food into geometry lessons through ethnomathematics fosters innovation. This method proves to be successful in instructing geometry, enhancing the subject's relatability and engagement for students [48]. The use of visual metaphors in ethnomathematics within this study enhances mathematical literacy by leveraging cultural context

and visual representations, thereby making abstract concepts more accessible and engaging for students. Visual metaphors serve to clarify intricate mathematical concepts by employing recognizable images and symbols, including conventional food items. This approach enhances comprehension and memory of mathematical concepts by connecting them to students' prior knowledge and experiences [49].

The application of visual metaphors aligns with cognitive learning theories like constructivism, which highlights the significance of context and active engagement in comprehending new information [40]. Visual metaphors enhance cognitive processing by transforming abstract concepts into more tangible and visually understandable forms [50]. Visual metaphors facilitate the visualization and comprehension of abstract concepts, which holds particular significance for students making the shift from concrete to abstract mathematical thinking [51].

Visual metaphors enhance communication in the classroom by establishing a shared visual language that educators and learners can utilize to engage in discussions about mathematical concepts. This common visual language serves to elucidate and strengthen mathematical concepts [52]. Projects that incorporate trigonometry with elements of local culture, like traditional foods, have demonstrated effectiveness in enhancing students' understanding of abstract mathematical concepts [53]. The integration of visual metaphors and cultural elements in mathematics education enhances student engagement and motivation. This method enhances the learning experience and maintains student engagement in mathematics. Ethnomathematics and visual metaphors promote the exploration of various problem-solving strategies, fostering the development of more adaptable mathematical approaches among students. This approach fosters the enhancement of analytical skills and the capacity to utilize mathematical principles across diverse situations.

This study demonstrates that ethnomathematics learning, which incorporates local cultural values into mathematics instruction, significantly enhances students' understanding and appreciation of Pancasila values. Ethnomathematics education enhances students' understanding of local culture, which is crucial for developing a sense of national identity and pride. Studying traditional houses enhances understanding of mathematical concepts while fostering cultural appreciation [54]. Incorporating local wisdom and cultural examples into the curriculum fosters a stronger connection to national identity among students, aligning with the values of Pancasila. This method has demonstrated effectiveness in educational institutions that have adopted local wisdom-based learning processes. [55]. The integration of cultural elements into mathematics enhances student engagement and acceptance of the subject. Enhanced engagement may result in a more profound comprehension and assimilation of Pancasila values [54].

Ethnomathematics aligns with character education, a fundamental aspect of Pancasila. Integrating Pancasila values into the curriculum fosters enhanced nationalism and ethical conduct among students. This method has demonstrated effectiveness in various disciplines, where Pancasila values are incorporated to promote national unity and integrity [56]. Employing real-life applications to impart Pancasila values through ethnomathematics offers significant experiential learning opportunities for students. Engaging with and applying these values within a community context can enhance comprehension and dedication to Pancasila [57].

Ethnomathematics entails the comprehension and application of mathematical concepts within cultural contexts, presenting complexities and challenges in implementation [58]. This complexity necessitates that educators modify their teaching methods to align with cultural characteristics, a task that may present challenges. Creating suitable teaching materials that incorporate Pancasila values and ethnomathematics is crucial. This involves the development of textbooks and lesson plans that accurately represent the diversity and richness of Indonesian culture [59]. To effectively integrate ethnomathematics with Pancasila values, it is essential to address challenges including complexity, curriculum integration, educator preparedness, the balance between modern and traditional values, and the development of resources for successful implementation.

CONCLUSION

The implementation of ethnomathematics learning utilizing visual metaphors leads to a notable enhancement in students' mathematical literacy skills. The increase in mathematical literacy test

scores demonstrates the ability to formulate mathematical problems from everyday situations, utilize mathematical concepts, facts, procedures, and reasoning to solve problems and interpret and communicate problem-solving results in an easily understandable manner.

The enhancement of Pancasila values contributes positively to the development of Pancasila students' profiles, particularly in the areas of critical and creative reasoning. Students are instructed in critical reasoning to analyze and solve mathematical problems within the framework of local culture. Students are encouraged to cultivate their creativity in designing solutions and producing works influenced by local culture.

The application of culturally relevant visual metaphors facilitates students' comprehension of abstract mathematical concepts. A student-centered learning approach that prioritizes hands-on activities enhances student motivation and engagement in the educational process. Integrating local cultural values in mathematics education enhances patriotism and reinforces students' character development.

The findings of this study suggest that the ethnomathematics learning model utilizing visual metaphors should be widely socialized and implemented in elementary schools. Educators must possess the knowledge and skills necessary for the development and implementation of ethnomathematics learning utilizing visual metaphors. Additional research is required to investigate the potential of ethnomathematics in mathematics education across different educational levels.

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