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# How do Indonesian students respond to ethnomathematics-based learning in the digital era?

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## ABSTRACT

The integration of ethnomathematics ((a combination of mathematical concepts with local culture) into education presents unique opportunities and challenges, particularly in the digital era where cultural and technological contexts converge. This study explores the responses of eighth-grade students in Indonesia to ethnomathematics-based learning centred on Balinese culture. Employing a qualitative descriptive approach, 42 students participated in interviews and essay tests designed to assess their abilities in solving culturally embedded mathematical problems. The findings reveal a strong enthusiasm among students, who found the approach engaging and novel. However, significant difficulties emerged in connecting mathematical concepts to cultural contexts, exposing a gap between student interest and problem-solving capabilities. The implications of this study underscore the urgent need for culturally responsive teaching methodologies capable of bridging the gap between theory and practice in the digital educational landscape. These findings provide a new direction for innovations in ethnomathematics education relevant to the needs of the 21st century.

## *Bagaimana respons siswa Indonesia terhadap pembelajaran berbasis etnomatematika di era digital?*

***Kata Kunci:***

*matematika budaya, penelitian kualitatif deskriptif, etnomatematika, budaya indonesia, keterlibatan siswa*

## *ABSTRAK*

*Integrasi etnomatematika ((kombinasi konsep matematika dengan budaya lokal)) dalam pendidikan menawarkan peluang dan tantangan yang unik, terutama di era digital di mana konteks budaya dan teknologi saling berkonvergensi. Penelitian ini mengeksplorasi respons siswa kelas VIII di Indonesia terhadap pembelajaran berbasis etnomatematika yang berfokus pada budaya Bali. Dengan menggunakan pendekatan deskriptif kualitatif, 42 siswa berpartisipasi dalam wawancara dan tes esai yang dirancang untuk menilai kemampuan mereka dalam menyelesaikan masalah matematika yang berbasis budaya. Temuan penelitian menunjukkan antusiasme yang tinggi di antara siswa, yang menganggap pendekatan ini menarik dan baru. Namun, terdapat kesulitan signifikan dalam menghubungkan konsep matematika dengan konteks budaya, mengungkapkan kesenjangan antara minat siswa dan kemampuan pemecahan masalah. Implikasi dari penelitian ini adalah kebutuhan mendesak akan metodologi pembelajaran responsif budaya yang mampu mengatasi kesenjangan antara teori dan praktik dalam lanskap* *pendidikan digital. Temuan ini memberikan arah baru bagi inovasi pembelajaran etnomatematika yang relevan dengan kebutuhan abad ke-21.*



**Contribution to the literature**

This research contributes to:

- Examining how the digital era influences student engagement with ethnomathematics, connecting traditional cultural contexts with modern technological advancements.
- Revealing the gap between students' positive attitudes toward ethnomathematics and their ability to solve problems effectively.
- Providing insights for designing curriculum strategies that integrate cultural heritage and digital tools to enhance student engagement and problem-solving skills.

## 1. INTRODUCTION

Mathematics education places a strong emphasis on students' ability to apply mathematical concepts and problem-solving skills in real-life contexts. Real-life applications of mathematical concepts help students see the relevance of what they are learning, fostering deeper engagement and understanding. The ability to apply these skills outside of the classroom equips students with practical tools for critical thinking and decision-making in daily life. Real-world problems offer students the opportunity to contextualize their learning, which not only reinforces their mathematical knowledge but also enhances their problem-solving capabilities by connecting abstract concepts to tangible experiences. These skills are vital for success, as mathematics underpins many areas of daily activities, from financial literacy to technological innovation.

The National Council of Teachers of Mathematics [1] outlines five key standards for mathematics learning: problem-solving, communication, reasoning, representation, and making connections. These standards highlight the importance of students being able to apply what they learn in varied contexts, including cultural and technological ones. In culture-based learning, for example, problem-solving is enhanced when students relate mathematical concepts to familiar cultural experiences. Similarly, technology-based learning engages students through interactive simulations or tools that simulate real-life problems, allowing them to use mathematics in novel ways. Both approaches emphasize the integration of real-life context, enhancing the relevance and application of mathematical principles.

One of the overarching goals of mathematics education is to connect students with their cultural surroundings [2]. This connection can be realized through approaches like ethnomathematics, which emphasize understanding mathematics within cultural contexts. Ethnomathematics encompasses mathematical practices within various cultural groups, from urban to rural settings, including indigenous peoples, workers, and children [3]. By recognizing the mathematics embedded in daily life activities and cultural practices, students are encouraged to view mathematical concepts not as abstract ideas but as tools for understanding and navigating their world.

Ethnomathematics represents a bridge between culture and mathematics, a connection that has been previously overlooked [4]. Traditionally, mathematics education has often been disconnected from students' lived experiences and cultural backgrounds, focusing instead on decontextualized and standardized content. This gap has resulted in missed opportunities for students to engage with mathematics in a meaningful way. For instance, research by D'Ambrosio [5] highlighted that many students struggle with mathematics because they perceive it as irrelevant to their cultural and social realities. Moreover, studies conducted by Powell and Frankenstein [6] found that integrating students' cultural knowledge into mathematics education enhances learning outcomes and fosters greater interest in the subject.

Grounded in the constructivist philosophy, ethnomathematics not only facilitates knowledge acquisition but also transforms students' self-perception and their role in the world. Cultural identity influences mathematical aptitude, as people's actions are often shaped by their immediate surroundings [7]. For example, how students approach problem-solving can be shaped by culturally specific methods of reasoning and decision-making. In the modern era, ethnomathematics plays a pivotal role in preserving and passing down Indonesian culture amidst the rapid advancement of information and communication technology, bridging traditional practices with contemporary educational methods.

However, the integration of ethnomathematics into the curriculum is not without challenges. While experts like Nur *et al.* [8] advocate for its inclusion to enhance students' mathematical skills, the widespread adoption of ethnomathematics in Indonesia faces obstacles. One key issue is the lack of teacher training and resources needed to implement culturally responsive pedagogy. In many cases, ethnomathematics remains confined to cultural research and experiments within select schools, particularly those with the resources and support to implement such initiatives [9]. Furthermore, there is a lack of standardized frameworks for incorporating ethnomathematics into the national curriculum, which hinders its broader implementation.

The differences between schools that have adopted ethnomathematics and those that have not are stark. Schools that integrate ethnomathematics often report higher student engagement, as students can relate mathematical concepts to their everyday lives. In contrast, traditional schools, which do not emphasize cultural context, may struggle to engage students, particularly those from marginalized communities [10]. Despite these successes, scaling this approach across the country requires addressing systemic barriers such as curriculum rigidity, insufficient teacher preparation, and a lack of awareness about the benefits of culturally contextualized mathematics education.

The time is ripe to integrate ethnomathematics into the national mathematics education curriculum to ensure that all students, regardless of their cultural background, can connect mathematics to their lived experiences and cultural heritage. Furthermore, in the digital era, where mathematics and technology are intertwined, mathematics learning has become more systematic through various digital learning media [9]. The characteristics of students in this digital age, characterized by a preference for quick access to information, multitasking, and reliance on communication technologies, necessitate educational approaches that maintain social engagement [11].

This research aims to bridge a critical gap in previous studies by investigating how the digital era is influencing Indonesian students' responses to cultural mathematics, particularly in the context of ethnomathematics. While prior research in Indonesia has explored the significance of ethnomathematics and its potential in mathematics education [12]–[16], there has been a limited focus on how technological advancements and changing paradigms in the digital age are shaping students' perceptions and abilities in applying ethnomathematics to real-world problems. This study will provide valuable insights into the impact of the digital era on students' attitudes and approaches to ethnomathematics, contributing essential knowledge for the development of curriculum strategies that effectively balance modern mathematical learning with culture-based mathematics [8]. It will address this gap by examining the evolving dynamics between technology, culture, and mathematics education, shedding light on the contemporary relevance of ethnomathematics in the digital era.

Furthermore, this study contributes to the existing body of knowledge by shedding light on the interaction between technology and cultural mathematics education, providing a deeper understanding of how these factors shape student learning. It addresses the need for culturally responsive teaching strategies that not only incorporate traditional cultural practices but also align with modern, technology-driven learning environments. This research will inform the development of curriculum strategies that effectively balance modern mathematical learning with culture-based mathematics, offering valuable insights into how educational frameworks can be adapted to meet the needs of students in the digital era. By doing so, it fills a critical gap in previous research and contributes to the growing recognition of the importance of integrating both cultural relevance and technological engagement in mathematics education.

Previous studies have been conducted on the application of ethnomathematics in mathematics learning using various approaches, including the effectiveness of ethnomathematics-based teaching materials [17], the exploration of Bugis ethnomathematics as a learning resource for mathematics [18], realistic mathematics learning based on ethnomathematics [19], and problem-solving skills through realistic mathematics learning based on ethnomathematics [20]. However, most of these studies primarily focus on the development of media or methods without specifically addressing how students respond to ethnomathematics problems within specific cultural contexts in the digital era.

This study aims to explore Indonesian students' responses to ethnomathematics problems based on Balinese culture in the digital era using a descriptive qualitative approach. The findings of this research contribute significantly to identifying the gap between students' interest in ethnomathematics and their ability to apply mathematical concepts within cultural contexts. Furthermore, this study offers pedagogical insights for developing learning strategies that integrate cultural contexts with digital technology to enhance students' engagement and problem-solving skills.

## 2. METHOD

### *2.1 Research Design and Participants*

We opted for a descriptive qualitative research framework, aiming to provide a comprehensive overview, expressed in layman's terms, of specific experiences encountered by individuals or groups [21]. Thus, our data stemmed from students' responses to ethnomathematical problems rooted in Balinese culture administered within the educational context. This study focuses on elucidating students' engagement with cultural mathematics. After receiving ethics approval, the research was conducted.

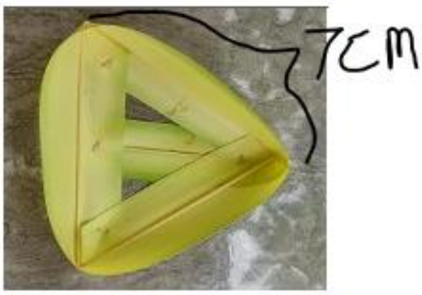
Our research was conducted at a Junior High School in Badung Regency, Bali, with eighth-grade students as participants. This school was selected due to its proactive approach to integrating Balinese cultural teachings, which contributes to the cultural preservation efforts in Bali. To ensure confidentiality, pseudonyms were assigned to people, places, and research sites [22]. After receiving consent from parents and students, the research was conducted. From the ten available classes, classes VIII.1 and VIII.5 were purposively sampled as they were deemed representative. A total of 42 students participated in the research. Geometric materials related to Balinese culture were utilized, incorporating ethnomathematical concepts such as those found in Balinese Hindu ceremonial structures and traditional Balinese architecture.

## 2.2 Data Collection Techniques

### 2.2.1 Test

In this study, data collection involved administering a descriptive test consisting of three questions pertaining to the ethnomathematics of geometric concepts within Balinese culture. Subsequently, the students' responses were analyzed to gauge their comprehension of these ethnomathematical principles embedded in Balinese cultural practices. Below are the problems presented to the students.

**Table 1.** Ethnomathematics Problems

| No | Problem | Expected Answer |
|---|---|---|
| 1 | Gede is preparing to construct a Klakat for an upcoming religious ceremony. He has been provided with 12 bamboo pieces ready for assembly. Each bamboo piece measures 25 cm in length and 1 cm in width. Help Gede determine the number of holes in the Klakat design, its area and perimeter, and the total area of the holes within the Klakat design!<br> | The answer expected from students is that they realize that the only Klakat that can be made is a Klakat with 3 x 3 holes. This is because each side of Klakat requires two pieces of bamboo. The area of the Klakat itself is 25 x 25 = 625 cm$^2$ and the perimeter is 4 x 25 = 100 cm. For the size of each hole, students are expected to realize that the width of the bamboo, which is 1 cm, affects the size of the hole, where the side of each hole = (25 –(4 cm + 2 cm))/3 = 19/3 cm ( 4 cm from 4 bamboos on the sides, 2 cm from 2 bamboos in the middle). So the total area of the hole is = 19/3 x 19/3 x 9 = 19 x 3 = 361 cm$^2$. |
| 2 | Sintia intends to craft an Ituk-ituk with dimensions akin to the one described below.<br><br><br>Suppose Sintia possesses busung (coconut leaves) that are each 1 meter long. What is the number of Ituk-ituk that can be crafted from one of these leaves depending on the dimensions of each Ituk-ituk and how efficiently the leaves are utilized? | The expected answer is that students find that to make one Ituk-ituk requires an arc of length 7 + 7 + 7 + the height of the Ituk-ituk. The Ituk-ituk's height is found using the Pythagorean formula, where: The Ituk-ituk height= $\sqrt{7^2+(7/2)^2}=7.8$ cm, so the total length of the busung required for an Ituk-tuk is 21 + 7.8 cm = 28.8 cm. So, a busung whose length is 1 m = 100 cm will produce: 100/28.8 = 3.47 and is rounded down to 3 Ituk-ituk. The remainder of the division also serves to leave the tip of the busung which cannot be made into Ituk-ituk because it is too small. |
| 3 | Mr. Made plans to construct a Pelinggih resembling the image depicted below on his property, which measures 10 meters by 10 meters. | The expected answer is to find how many Pelinggih can be lined up. Students need to calculate the length of the base side of the Pelinggih roof first by:<br>V = 1/3 x Base Area x Height, 4 = 1/3 x Based Area x 1<br>Based Area = 12<br>Base side = $\sqrt{12}=3.46$. |

Given that the Pelinggih roof is 1 meter high and has a volume of 4 cubic meters, determining the number of Pelinggih that can be lined up on the ground would require additional information about its dimensions and layout!

To ensure the validity of the test instrument used in this study, an expert review was conducted with a panel comprising two professionals: one lecturer specializing in mathematics education and one teacher with extensive experience in ethnomathematics and Balinese culture. This review involved a comprehensive evaluation of each test item to assess its relevance, clarity, and alignment with the study's objectives. The lecturer provided insights into the educational theories underpinning the questions, while the teacher offered practical perspectives on their applicability in a classroom setting. Their combined feedback was instrumental in identifying ambiguities and content gaps, leading to revisions that enhanced the overall quality and validity of the test. By incorporating the perspectives of both an academic and a practicing educator, we aimed to create a robust instrument that accurately reflects the intended constructs of the study.

Furthermore, students are expected to realize that in Hindu temples, the Pelinggih are only lined up on the edge of the temple, so if the length of the land side is 10 m, each side of the land can only contain 10/3.46 = 2.9 or rounded down to 2 Pelinggih. However, the most important thing here is that students draw a plan for the placement of the Pelinggih and not just answer procedurally. They also realize that Hindu temples usually don't place the Pelinggih in the middle of the land. The appropriate design is shown in Figure 1.

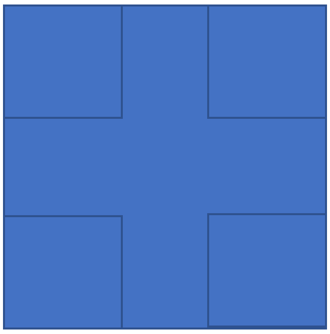


**Figure 4.** Pelinggih Placement

It can be seen in the picture that on each side, there are two Pelinggih, and the safest placement is in the corner of the land to provide a space in the middle of the temple land. So, the total Pelinggih that can be lined up is 4 Pelinggih. For the first “What-If” question, if only the area of the land is 100 m2, students can estimate variations in the length of the sides, including 100 x 1, 50 x 2, 25 x 4, 20 x 5, 10 x 10. 100 x 1 and 50 x 2 alone cannot be used because the length of the base of the Pelinggih roof itself is more than 3 m; therefore, only 3 variations of soil size can be used, namely: 25 x 4, 20 x 5, and 10 x 10.

So, students just place the Pelinggih on the side of the ground as in the beginning and get variations of the many Pelinggih that can be lined up.

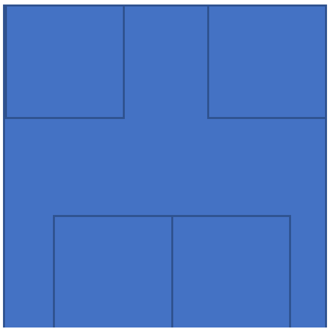


**Figure 2.** Ground Plans of the Sanggah

Figure 2 shows the two squares below have merged into one, which characterizes one Pelinggih with twice the length of the other Pelinggih. Thus, the total number of Pelinggih lined up is three.

#### *2.2.2 Interviews*

We also conducted interviews to support the data obtained. Interviews were conducted with 4 students who represented the other students. The selection of students was carried out randomly in each aspect, and the aim was to find out how students' opinions on ethnomathematical problems in Balinese culture were given and the reasons students chose these responses. Interviews were conducted once after the data analysis was completed. The type of interview used is a semi-structured interview.

### *2.3 Data Analysis and Representation*

The qualitative descriptive data analysis method employed in this study follows the subsequent steps.

#### *2.3.1 Data Reduction*

The initial stage of qualitative data analysis is data reduction [21]. This involves the selection, concentration, streamlining, abstraction, and modification of data present in field notes or transcriptions. Data reduction is an analytical process that clarifies, categorizes, directs, discards irrelevant information, and organizes data to facilitate the drawing and validation of inferences. This process entails selecting, focusing, simplifying, and abstracting raw data recorded in field notes. The steps involved in data reduction for this study are outlined as follows: (1) Reviewing student work outcomes, which are subsequently assessed to gain insights into students' proficiency in solving real-world arithmetic problems; (2) Transforming the findings from student work into notes for interview material, and (3) Condensing the interview outcomes into clear, concise paragraphs, which are then transcribed into notes.

#### *2.3.2 Data Display*

The second-level model of qualitative data analysis is data display [22]. Going beyond data reduction, data display aims to create "an organized, condensed compilation of information that facilitates drawing conclusions..." Through a systematic arrangement of information known as data presentation, informed decisions and actions can be made. In this context, student work data is now structured in alignment with the study's objectives.

### *2.3.3 Conclusion Drawing and Verification*

Conclusion drawing involves taking a step back to analyze the interpreted data and evaluate their implications for the research questions. Verification, closely associated with conclusion drawing, requires revisiting the data repeatedly to validate the emerging conclusions. The meanings emerging from the data have to be tested for their plausibility, their sturdiness, their confirmability, and their validity. Verification serves as a final step in addressing research questions and objectives. Conclusions regarding the identification and causes of student errors in practical scenarios can be drawn by comparing the results of student work with the insights gained from interviews.

## 3. RESULTS AND DISCUSSION

### *3.1 Students' Interest in Ethnomathematics*

According to the findings of our interviews, more than 80% of pupils seemed interested in the supplied ethnomathematical questions. Students tend to think that the ethnomathematical questions given are challenging and interesting questions to work on. The following are excerpts of interviews with some representative students:

| | | |
|---|---|---|
| Teacher | : | *After answering three ethnomathematical questions, what do you think about these questions?* |
| Student 1 | : | *Honestly, this is the first time I have received this type of math problem, sir.* |
| Teacher | : | *Do you think this question is difficult?* |
| Student 2 | : | *Actually, it's not that difficult, sir, but I have to understand Balinese cultural concepts first. I was surprised because there are mathematical concepts in Balinese culture that I often see.* |
| Teacher | : | *Are you interested in working on questions like this again in the future? Why?* |
| Student 4 | : | *I am interested sir, because I find this question challenging, not too difficult, but I need to think deeper to solve it, such as answering a riddle.* |
| Teacher | : | *Okay, so do you think this question is suitable for teaching mathematics at school?* |
| Student 3 | : | *I agree, sir. This question seems good for refreshing our minds from difficult questions that have many formulas.* |
| Student 2 | : | *That's right, sir. Questions like these can also help us learn more about Balinese culture.* |

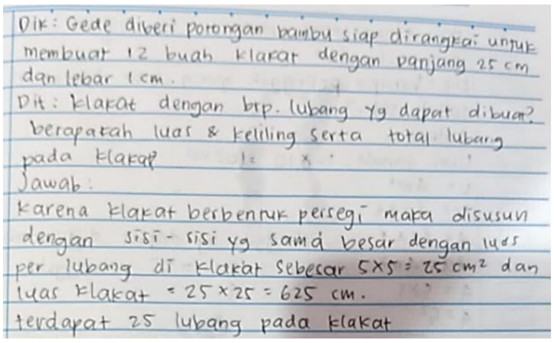
Based on the results of the interview, students showed interest in the ethnomathematical questions about Balinese culture. This is because students feel that questions related to their own culture give a pleasant and familiar impression. Students also feel that answering ethnomathematics questions can make them better understand their own culture. Students have responded favorably to ethnomathematics, which supports the idea that when context and involvement are present during the learning process, students are better able to retain the lesson and are more inclined to apply what they have learned to their daily lives [23]. As a result of their education, students are better equipped to live in societies that value cultural diversity, exhibit critical reflexivity toward social justice, and understand their obligations as citizens. This highlights the importance of integrating culturally responsive teaching strategies to foster meaningful and transformative learning experiences.

Students also consider ethnomathematics to be very suitable for use in learning. Students feel many benefits from studying ethnomathematics. Ethnomathematics is seen as important in learning because paying attention to students' shared experiences can be helpful in education [24]. Through cultural-based sharing of experiences, students can understand mathematics more realistically and understand the mathematical concepts contained in their culture.

### *3.2 Students Abilities in Solving Ethnomathematics Problems*

The enthusiastic reception displayed by the students did not align with their proficiency in solving ethnomathematical problems. A majority of students encountered difficulties when confronted with ethnomathematical problems rooted in Balinese culture. Many students struggled to comprehend the provided ethnomathematical problems and failed to translate cultural contexts into mathematical concepts. Below are examples illustrating students' responses:

In addressing Problem 1, students often demonstrated a lack of comprehension of the problem, leading to errors in calculations. Additionally, students struggled to identify pertinent information from the given problems. The following exemplifies students' responses.

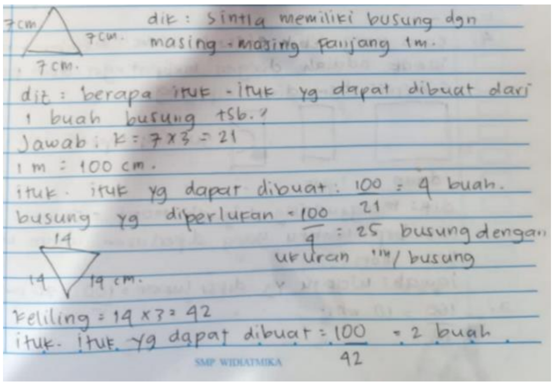

Dik: Gede diberi potongan bambu siap dirangkai untuk membuat 12 buah klakat dengan panjang 25 cm dan lebar 1 cm.
Dit: klakat dengan brp. lubang yg dapat dibuat? berapakah luas & keliling serta total lubang pada klakat
Jawab:
karena klakat berbentuk persegi maka disusun dengan sisi-sisi yg sama besar dengan luas per lubang di klakat sebesar 5x5 = 25 cm² dan luas klakat = 25 x 25 = 625 cm.
terdapat 25 lubang pada klakat

**Translation:**
Knowing: Gede received bamboo sticks ready for assembly to create 12 Klakat, each 25 cm long and 1 cm wide.
Question: How many holes can be made in each Klakat? What are the area and perimeter of the total holes in the Klakat?
Answer: Given that the Klakat is square-shaped, with each side having the same length, the area of each hole can be determined as 5 x 5 = 25 cm². The total area of the Klakat is calculated as 25 x 25 = 625 cm². Thus, there are 25 holes in the Klakat.

**Figure 3**. Example of Student's Answer in Problem 1

Figure 6 indicates that the student did not fully grasp the information presented in the questions. From the "knowing" part of the student's answer, it's apparent that the student comprehended the dimensions of the bamboo sticks (25 cm x 1 cm) but mistakenly assumed that the given number of bamboo sticks (12 pieces) corresponded to the number of Klakat to be constructed. Additionally, the student derived the hole size from the Klakat as 5 x 5 cm without providing any rationale for this choice. Although the students understood the purpose of the question, they struggled to comprehend the provided information fully.

In addressing Problem 2, students seemed to struggle with accurately understanding and extracting relevant information from the questions. Their difficulties were particularly evident in distinguishing between the cultural context of the problem and the mathematical concepts needed to solve it. Some students had trouble comprehending the cultural references embedded in the problem, while others found it challenging to apply the appropriate mathematical formulas once the context was understood. This highlights the need for instructional strategies that integrate cultural understanding with mathematical reasoning to enhance problem-solving skills.



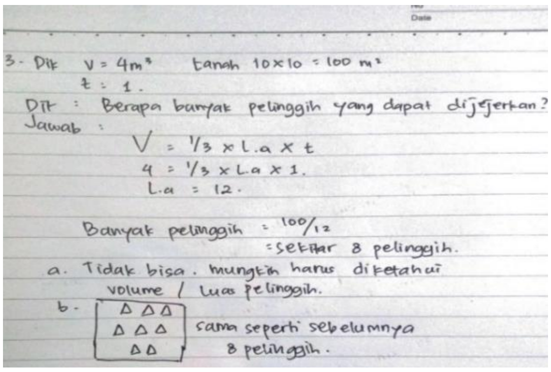

**Translation:**

Image depicting an equilateral triangle with a side length of 7 cm
Given: Sintia possesses busung (coconut leaves) measuring 1 m in length. Query: How many Ituk-Ituk can be crafted from a single busung?
Response: Perimeter = 7 x 3 = 21 1 m = 100 cm The quantity of Ituk-Ituk that can be produced: 100/4 = 4 units Hypothetical Scenario The quantity of busung required = 100/4 = 25 busung, each with a length of 1 m Image showing an equilateral triangle with a side length of 14 cm Perimeter = 14 x 3 = 42 The number of Ituk-Ituk that can be fashioned = 100/42 = 2 units

**Figure 4.** Example of Student's Answer for Problem 2

Figure 4 shows evidence that the students did not fully grasp the given questions. Despite providing simple reasoning, students overlooked the central part of the Ituk-ituk, which requires an additional component. Consequently, students only accounted for the sides of the Ituk-ituk, leading to an overestimation of the number of Ituk-ituk they could produce using one busung.

Problem 3 represents the most complex challenge among the three, requiring students not only to comprehend the questions and provide information but also to create appropriate representations to arrive at the correct answer. Figure 5 shows examples of student responses from the high-performing group to Problem 3.




**Translation:**

1. Knowing:

V = 4 $m^3$, Height = 1 m
Ground = 10 x 10 = 100 $m^2$
Question: What is the number of Pelinggih that can be lined up?
Answer:
V = 1/3 x Base Area x Height
4 = 1/3 x Based Area x 1
Based Area = 12
The number of Pelinggih = 100/12 = around 8 Pelinggih
"What-If" Question:

2. It can't. Maybe the volume/area has to be known
3. Picture of Sanggah design same as before, 8 Pelinggih

**Figure 5.** Example of Student's Answer for Problem 3

From Figure 5, it is apparent that the student struggled to fully comprehend the problem and was less successful in formulating appropriate problem-solving strategies. While the students recognized the need to first determine the size of the Pelinggih roof base to ascertain the number of Pelinggih that could be arranged on the land, they halted after calculating the base area of the Pelinggih roof. Subsequently, the student resorted to procedural methods to determine the number of Pelinggih that could be lined up by dividing the land area by the area of the Pelinggih roof base. This approach reflects a reliance on basic arithmetic without integrating a deeper conceptual understanding of spatial arrangement.

This approach, however, yields an inaccurate result as it fails to account for several key factors. Firstly, not all 8 Pelinggih can fit on the land, necessitating the use of the side length of the Pelinggih roof base and the creation of an appropriate plan to determine the feasible number of Pelinggih that can be lined up. Secondly, the student overlooked the customary practice in Hindu temples, where Pelinggih are typically not placed in the center of the land but are instead aligned along the sides. Consequently, the student's answers were deemed incorrect.

A more systematic and context-aware approach is required to obtain a more accurate result in determining the number of Pelinggih that can be placed on the land. First, students should employ a spatial planning strategy, creating a scale drawing or layout of the land and Pelinggih. This visual representation will help them assess the dimensions and spacing needed for each Pelinggih accurately. Incorporating traditional architectural principles related to Hindu temple layouts, which emphasize spacing and orientation, will guide their planning.

The enthusiastic response demonstrated by these students indicates a positive reception to the concept of ethnomathematics within Balinese culture. Ethnomathematics not only captures students' interest but also provides a stimulating platform for enhancing their mathematical skills [23]. Students perceive ethnomathematics, particularly in the context of Balinese culture, as an engaging and enjoyable avenue for learning and problem-solving [6].

These findings are consistent with the research of Wulantina *et al.* [12], which suggests that mathematics teaching materials rooted in ethnomathematics can foster students' interest, motivation, and overall satisfaction with learning mathematics. Similarly, Khairida observed a significant increase in students' interest in learning and cognitive development through the implementation of an ethnomathematical-based learning approach. Ethnomathematics-based learning not only enables students to grasp mathematical concepts but also promotes the development of higher-order thinking skills and self-concept, as reported by teachers [24]–[27]. This approach facilitates a deeper understanding of mathematical principles while making the subject more accessible to students. It was observed that students had difficulty comprehending realistic mathematical problems, including those related to ethnomathematics. Although students were familiar with their own culture and the traditional ceremonial facilities and buildings presented in the questions, they admitted to paying less attention to these cultural aspects in their daily lives. This raises the question of whether this disconnect is related to how culture is presented in schools or if it is influenced by other factors, such as the increasing impact of modernization and technology, which may divert students' focus away from traditional cultural practices.

Additionally, students expressed that the mathematics education they had received so far did not promote a deep understanding of concepts or problem-solving in real-life contexts [28]. Their tendency to approach learning procedurally led to mathematical concepts becoming detached from real-world applications and their immediate environment. This aligns with Simon's [29] assertion that students who primarily rely on mathematical formulas and procedures often struggle with conceptual understanding. Furthermore, Dündar & Gündüz [30] stated that attempting to teach or learn mathematics, particularly geometry, without connecting it to daily life experiences could hinder comprehension of the subject matter.

The students' responses indicated that they were not consistently able to grasp the concept of ethnomathematics. They struggled to extract essential ideas from the presented problems, resulting in errors in formulating settlement plans and ultimately yielding incorrect results. Payadnya et al. found that students could not often understand their surrounding environment, including realistic concepts rooted in their own culture [31]. This hindered their ability to correctly interpret ethnomathematical problems. Additionally, Cahirati *et al.* [32] observed that students' difficulty in understanding realistic problems stemmed from their inability to gauge variable magnitudes based on problem instructions and their challenges in interpreting question prompts, which often led to incorrect problem-solving approaches.

Ethnomathematics-based learning holds the potential to enhance students' understanding of both mathematics and their environment [33]. A strong grasp of realistic mathematics is crucial for developing critical thinking skills and problem-solving abilities. Realistically-oriented math education helps students acquire discipline and valuable life skills, such as patience, responsibility, cooperation, and empathy [34], [35]. Through ethnomathematics, students can gain insights into their environmental conditions and leverage their mathematical skills to tackle various real-world challenges. To comprehend the world's complexities, students must engage in classification and categorization processes that occur through cultural and social interactions, allowing them to distinguish themselves from others [36]. Socio-cultural elements guide students toward becoming individuals who actively contribute to their environment, underscoring the potential for improved mathematics learning when rooted in culture.

By leveraging digital resources, students can access a wealth of information about their cultural heritage, facilitating deeper connections between mathematical principles and real-world applications. Furthermore, the digital era fosters global communication, enabling students to share their ethnomathematical insights with peers worldwide, thus broadening their perspectives and enhancing their critical thinking skills. As students navigate the complexities of the modern world, the combination of ethnomathematics and digital technologies empowers them to approach real-world challenges with creativity and innovation, fostering a generation of learners who are equipped to contribute meaningfully to their communities and beyond.

The findings of the study Kolikant [37] align with this research, which examines students' responses to ethnomathematics-based learning in the digital era. That study demonstrated that culture-based approaches have the potential to enhance student interest and engagement; however, challenges remain in integrating mathematical understanding with the cultural contexts offered. This supports the findings where students showed enthusiasm for the ethnomathematics approach but faced difficulties in applying mathematical concepts to culture-based situations. Both studies highlight the importance of learning strategies that combine cultural contexts with digital technology approaches to bridge the gap between student engagement and conceptual understanding. Thus, this research provides a strong foundation for developing innovative teaching methods that not only enhance student participation but also deepen their understanding of mathematical content.

This study excels in increasing student engagement through an ethnomathematics approach that is both engaging and relevant to Balinese culture, offering a new platform for developing mathematical skills. However, there are some drawbacks, such as students' difficulties in understanding ethnomathematics concepts and connecting them to cultural contexts. These challenges are largely due to the dominance of procedural learning and a lack of attention to cultural elements in daily life. To address these issues, it is recommended that more effective pedagogical strategies be developed to help students more easily connect mathematical concepts to real-world contexts. Additionally, teachers should receive specialized training to integrate ethnomathematics approaches into the curriculum more systematically so that culture-based learning can be implemented more effectively and yield optimal results.

## 4. CONCLUSION

The findings of this research highlight that students exhibited a positive attitude toward the ethnomathematical concepts and problems embedded within Balinese culture. They perceived these concepts and problems as engaging, challenging, novel, and intriguing. Nonetheless, a notable limitation emerged as the majority of students struggled to grasp the intricacies of ethnomathematics in the Balinese cultural context. They encountered difficulties in extracting key ideas from the presented problems, often leading to incorrect solutions. It is important to acknowledge that this limitation may stem from students' limited familiarity with and appreciation for their own culture, compounded by a historical emphasis on procedural instruction. In light of these limitations, we recommend that educators focus on delivering mathematics education that is more grounded in real-world applications, particularly those rooted in students' cultural contexts. This approach has the potential to enhance students' comprehension of ethnomathematical concepts and foster a deeper connection between their mathematical learning and their cultural identities. Future research endeavors may explore additional factors contributing to these limitations and develop tailored pedagogical strategies to address them effectively. This study contributes to the development of culturally responsive teaching methodologies, addressing the needs in an increasingly digital educational landscape.

## AUTHOR CONTRIBUTION STATEMENT

IPAAP contributed to the writing of the article, analysis of research methods, data collection and processing, implementation of data analysis, preparation of results, and discussion sections. KAW contributed to the writing of the article, analysis of research methods, data collection and processing, implementation of data analysis, preparation of results, and discussion sections. IGANTJ contributed by providing direction and guidance in topic development, assisting in writing and editing, and providing input on relevant references and literature. IMW contributed by providing direction and guidance in topic development and assisting in writing and editing. KRP contributed by providing direction and guidance in topic development and assisting in writing and editing.

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