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Unveiling the ethnomathematics in Yogyakarta's Sultan palace architecture

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Abstract

The architecture of the Sultan's Palace in Yogyakarta offers a compelling opportunity to engage students in mathematics education while simultaneously contributing to preserving and promoting local cultural heritage from an early age. This research aims to explore the ethnomathematics embedded within the architectural design of Yogyakarta's Sultan Palace to facilitate elementary school students' comprehension of mathematical concepts, particularly those related to numbers. Employing a qualitative approach, this study investigates the ethnomathematical dimensions of the Sultan's Palace architecture through comprehensive observation and analysis. The methodology involves examining the architectural features, identifying conceptual underpinnings, and establishing criteria to validate the traditional practices embodied in the palace's design. Based on these findings, new criteria for mathematics education are proposed. The research focuses on various elements of the Sultan's Palace, including Kemandungan Lor/Plataran Keben, Bangsal Pancaniti, Regol Bangsal Pancaniti, Bangsal Sri Manganti, Penjagen Dragunder, Bangsal Manis, Bangsal Mandhasana, Ward Kotak, Gedhong Jene, Kasatriyan, Bangsal Kencana, and Danapratapa Gate. The results indicate that the architectural features of the Sultan's Palace offer valuable insights into teaching mathematical concepts across several domains, such as numbers, algebra, measurement, geometry, data analysis, and probability. Specifically, the study aims to uncover geometric patterns, shapes, and principles integrated into the palace's design. This research contributes to cultural preservation by documenting and analyzing the application of mathematics in the Sultan's Palace architecture—an aspect often neglected. Additionally, the findings hold significant implications for education by providing innovative teaching materials that intertwine cultural and mathematical elements, thereby enhancing students' understanding of mathematical concepts.

Keywords: architecture, ethnomathematics, mathematical concepts, Yogyakarta's sultan palace

Introduction

Traditional architecture often embodies the culture and history of a society. In Indonesia, and particularly in Yogyakarta, the Sultan Palace represents an exemplary model of traditional architecture infused with rich cultural and historical significance. The Sultan Palace functions not only as the royal family's residence but also as a hub for ritual activities, administrative functions, and Javanese cultural arts. While the aesthetic and cultural richness of traditional architecture like the Sultan Palace is widely acknowledged, its underlying mathematical principles are frequently overlooked (Woodward, 2007).

Many architectural elements are typically viewed solely through the lens of art and culture, with their mathematical dimensions often disregarded. For instance, the proportions, room layouts, and use of symmetry and geometry in the Sultan Palace are grounded in profound mathematical principles, yet these aspects are seldom explored in detail (Rifa'i et al., 2023). Mathematics and architecture are inherently interconnected; studying one invariably involves engaging with the other (Leopold & Ostwald, 2022). Conversely, architecture can serve as an effective medium for teaching mathematics (Ayuningtyas & Setiana, 2019; Supiyati & Hanum, 2019; Utami et al., 2019).

Both traditional and modern buildings offer diverse forms that can facilitate mathematical instruction. Indonesia is home to several architectural treasures, including the Borobudur Temple (Muhammad & Marsigit, 2019), Rumah Gadang (Fauzan et al., 2020), and numerous mosques (Hambali et al., 2022). Despite the cultural importance of the Sultan Palace's architecture, its mathematical dimensions remain largely unexplored. This research aims to document and analyze these principles, addressing a gap in the literature concerning the ethnomathematics of traditional Javanese architecture.

Previous studies have investigated the ethnomathematics of the Sultan Palace, such as the development of student worksheets based on its architectural features (Setiana, 2018). While these studies demonstrate the validity, practicality, and effectiveness of such worksheets, they often lack comprehensive explanations of the covered materials. Other research includes the use of photographs of the Sultan Palace to teach concepts like flat-sided space circles to junior high students and explores various ethnomathematical resources within the Palace (Mauluah, 2022).

This research does not solely focus on architectural elements but also on the ethnomathematical aspects categorized by D'Ambrosio (2015), namely counting, weighing, measuring, sorting, and comparing. These aspects can be utilized to teach mathematical concepts such as length, area, volume, tessellation, shape, pattern, common multiples, and common divisors at the elementary level (D'Ambrosio, 2015). Additional studies have explored learning materials that integrate geometric shapes and ceramic patterns from the Palace (Mauluah, 2022). Previous research has primarily concentrated on geometry within the Palace's architecture for elementary and junior high school levels (Humaeroh & Rahayu, 2022; Tutak et al., 2011; Verner et al., 2013; Wijayanto, 2017; Wulandari & Fitrianawati, 2021). However, there remains a gap in comprehensively understanding the application of ethnomathematics to other aspects of the Palace's architecture, particularly for elementary students. Further investigation is needed to fully explore the potential of ethnomathematics in the Palace's architecture and enhance mathematics learning materials in schools. This research aims to identify and analyze mathematical concepts present in the architectural elements of the Sultan Palace through an ethnomathematical approach. The objectives include revealing the mathematical principles embedded in the Palace's architecture, developing integrative mathematics learning materials, and promoting cultural preservation and education.

Methods

This study employs a qualitative approach to uncover the ethnomathematics embedded in the architecture of the Sultan Palace, with the objective of utilizing these insights as educational material for understanding relevant mathematical concepts. The study design is informed by Alangui's ethnomathematics framework (Alangui, 2010; Prahmana & D'Ambrosio, 2020; Utami et al., 2019), as illustrated in Figure 1. This framework guides the qualitative investigation of the architectural elements of Yogyakarta's Sultan Palace through the lens of ethnomathematics.

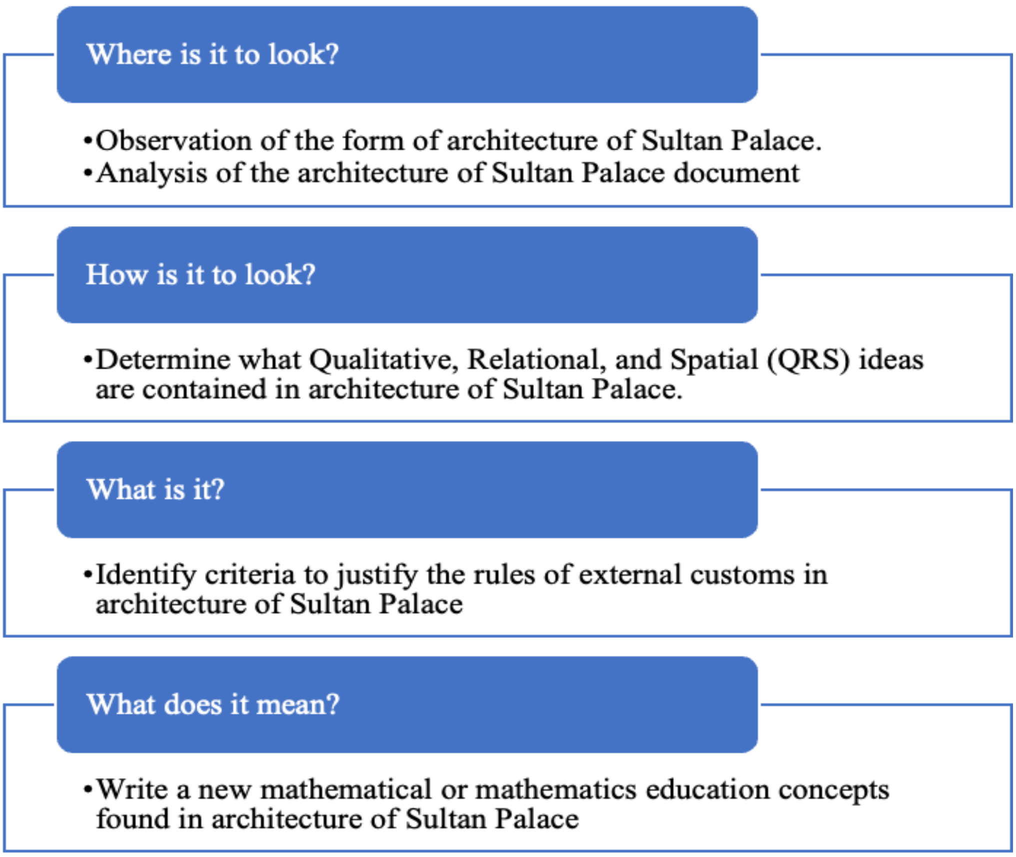


Figure 1. Ethnomathematics Study Framework

This research adheres to the Alangui ethnomathematics framework for several compelling reasons that underscore its relevance and effectiveness in studying the architecture of Yogyakarta's Sultan Palace. The justifications for selecting the Alangui framework include:

1. Holistic Approach
   The Alangui framework offers a comprehensive approach to studying ethnomathematics, encompassing the cultural, social, and environmental dimensions that influence the application of mathematics in traditional societies. This approach is particularly pertinent for examining the architecture of the Sultan Palace, which embodies significant cultural and historical values. By adopting a holistic perspective, this research can explore how mathematical concepts are embedded in architectural designs that reflect the cultural and social values of the Yogyakarta community (Fauzi et al., 2022; Zuliana et al., 2023).
2. Focus on Cultural Practices
   The Alangui framework emphasizes understanding cultural practices within local contexts, including the application of mathematics in daily life and cultural expressions. The architecture of Yogyakarta's Sultan Palace is deeply rooted in cultural practices, where mathematical principles have traditionally influenced the design and construction of buildings. This framework enables researchers to elucidate how mathematical principles present in the Sultan Palace's architecture are connected to the cultural practices of the local community (Setiana et al., 2021).
3. Integration of Theory and Practice
   Alangui's framework facilitates the integration of mathematical theory with traditional practices, allowing for a connection between theoretical concepts and their application in a cultural context. In the context of the Sultan Palace's architecture, this means linking mathematical principles such as symmetry, geometry, and proportion with their practical application in traditional architectural design, thereby offering a deeper understanding of mathematics in real-world contexts (Fauzi et al., 2022).

The research methodology involves several key stages:

1. Preparation Stage
   a. Literature Review
      Researchers conducted a comprehensive review of literature to grasp concepts of ethnomathematics and traditional Javanese architecture, identifying existing research gaps.
   b. Research Planning
      Researchers developed a detailed research plan, including data collection techniques, interview guides, and research schedules.
2. Data Collection Phase
   a. Observation
      Researchers performed participatory observations at the Sultan Palace, documenting architectural elements and recording field findings.
   b. Interviews
      In-depth interviews were conducted with selected informants, with conversations recorded and transcribed.

   c. Document Collection
      Relevant documents from various sources, including literature, archives, and previous studies, were collected.
   d. Artifact Analysis
      Researchers analyzed artifacts within the Sultan Palace, documenting and examining the mathematical elements present.
3. Data Analysis Stage
   a. Coding and Categorization
      Data from observations, interviews, and document studies were coded and categorized according to key themes related to mathematical concepts in the Palace's architecture.
   b. Thematic Analysis
      Thematic analysis was employed to identify patterns and mathematical principles in the data, correlating them with Alangui's ethnomathematics theory.
   c. Data Validation
      Data validity was ensured through triangulation by comparing findings from various sources and methods.
4. Reporting Stage
   a. Report Writing
      A comprehensive research report was compiled, detailing the background, methods, findings, and conclusions.
   b. Teaching Material Development
      Based on the research findings, a mathematics learning module was developed that integrates ethnomathematics concepts from the Sultan Palace's architecture (Pathuddin & Raehana, 2019).

By employing a rigorous data collection process and utilizing triangulation of sources, methods, and theories, this study aims to provide detailed and accurate insights into the application of mathematical concepts within the architecture of Yogyakarta's Sultan Palace. The triangulation approach ensures the accuracy, consistency, and relevance of the data, contributing to the development of contextual and meaningful teaching materials for primary school mathematics education.

Results and Discussion

Interviews conducted with Abdi Dalem Keraton Yogyakarta (Sri, October 2024) revealed that the Sultan Palace is divided into several distinct sections, each reflecting historical philosophies embedded in its design. Constructed in 1755 as a result of the Giyanti Agreement, Yogyakarta's Sultan Palace serves both as a residence for the Sultan and as a hub for cultural activities. The architectural design of the palace incorporates influences from European (Portuguese, Dutch) and Chinese cultures. Sri Sultan Hamengkubuwono I, the architect and founder of the Sultanate of Yogyakarta, played a pivotal role in its design.

Figure 2. Bangsal *manis*

The Sultan Palace is organized into three primary sections: the front complex, the core complex, and the back complex.

1. The Front Complex
   This area includes the Gladhjak-Pangurakan (Main Gate), Ler Square, and Gedhe Mosque.
2. The Core Complex
   This section comprises seven courtyards extending from the North Square to the South Square. These courtyards are Pagelaran, Sitihinggil Lor, Kamandungan Lor, Srimanganti, Kedhaton, Kemagangan, Kamandungan Kidul, and Sitihinggil Kidul.
3. The Rear Complex
   This area encompasses Alun-Alun Kidul and Plengkung Nirbaya.

The architecture of Yogyakarta's Sultan Palace predominantly exhibits classical Javanese architectural patterns, including joglo, limasan, and tajug styles. Within the palace complex, various buildings serve different functions and bear distinct names, such as Kemandungan Lor/Plataran Keben, Pancaniti Ward, Regol Pancaniti Ward, Sri Manganti Ward, Penjagen Dragunder, Sweet Ward, Mandhalasana Ward, Kotak Ward, Gedhong Jene, Kasatriyan, Kencana Ward, and Danapratapa Gate.

Figure 3. Gedhong Jane

The buildings in Yogyakarta's Sultan Palace are categorized into three types:

1. Gedhong: Enclosed buildings surrounded by walls on all sides.
2. Ward (Bangsal): Open structures used for various purposes.
3. Regol: Roofed structures that function as gates or entrances connecting different courtyard complexes.

Both the "ward" and "gedhong" structures predominantly employ traditional building forms such as limasan (Figure 2 and Figure 3) and joglo (Figure 4).

Based on the architectural styles and forms of Yogyakarta's Sultan Palace, several elements exhibit distinct characteristics that are relevant for teaching mathematics, especially to elementary school students. Notable features include the palace's roof designs and columns, which are often adorned in dark green or black with decorations in yellow, light green, red, gold, and other colors.

The architecture of Yogyakarta's Sultan Palace incorporates mathematical concepts that can be effectively utilized for educational purposes. Specific architectural components that can be explored include Kemandungan Lor/Keben Court, Pancaniti Ward, Pancaniti Ward Regol, Sri Manganti Ward, Penjagen Dragunder, Sweet Ward, Mandhalasana Ward, Kotak Ward, Gedhong Jene, Kasatriyan, Kencana Ward, and Danapratapa Gate.

These elements can serve as valuable media for teaching ethnomathematics at the elementary school level. They offer opportunities to integrate mathematical concepts such as symmetry, geometry, and proportions into learning activities, enhancing students' understanding of both mathematics and cultural heritage. By using these architectural features as educational tools, educators can create engaging and contextually relevant learning experiences for students in Phases A, B, and C of their elementary education.

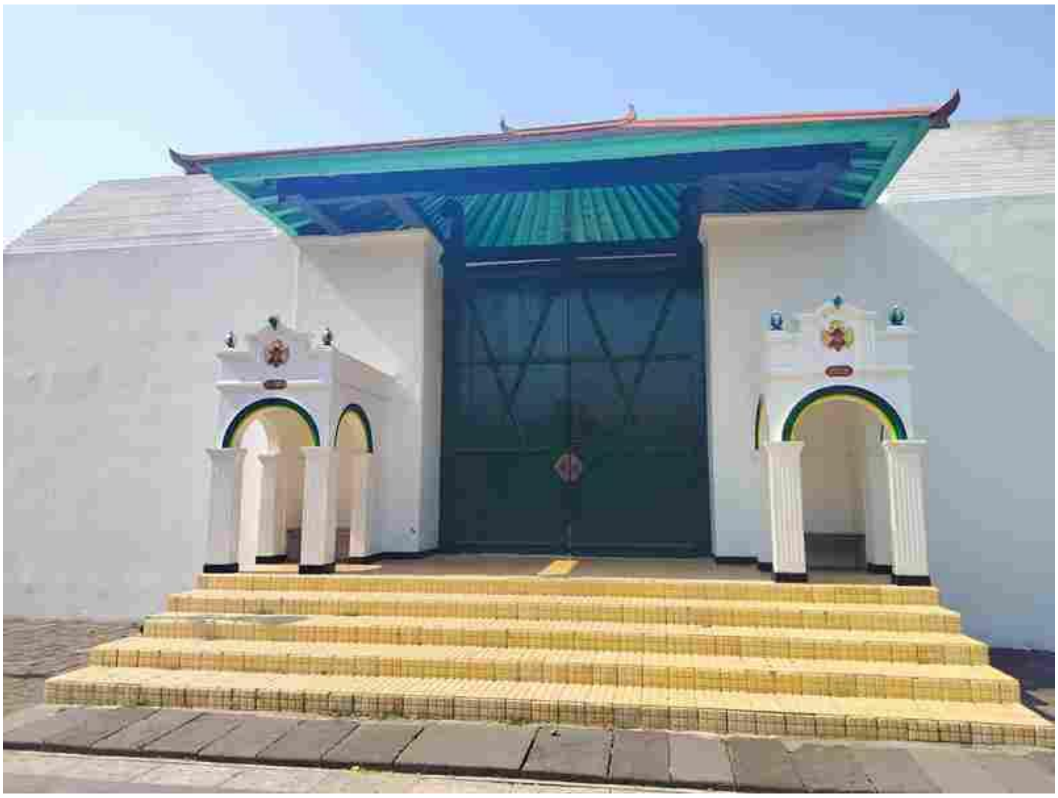
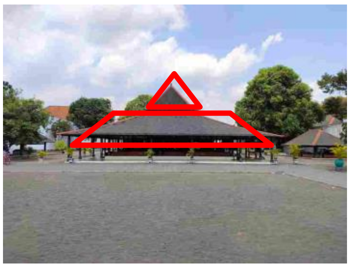
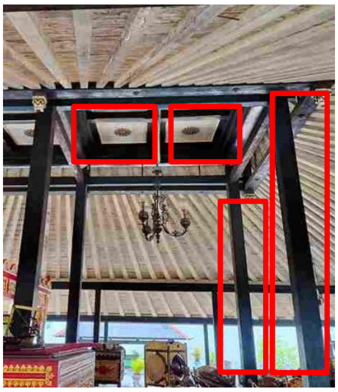
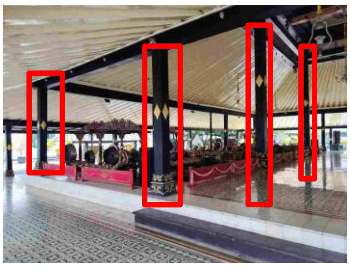


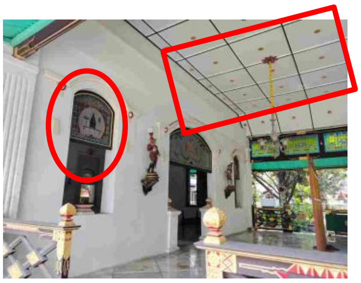
Figure 4. Regol Bangsal Pancaniti

The architecture of Yogyakarta's Sultan Palace provides a rich source of mathematical concepts that can be incorporated into educational materials for elementary school students. The following examples illustrate how various aspects of the palace's architecture can be used to teach mathematical concepts across different phases of elementary education, such as phase A (grades 1-2), phase B (grades 3-4), and phase C (grades 5-6), which will be described in the Table 1.

Table 1. Mathematical Value in Yogyakarta's Sultan Palace Architecture

No	Building Name	Image	Math Value
1	Kamandungan Lor/Plataran Keben (a place to store gamelan)		1. Recognize shapes (1D, 2D, and 3D geometry or non-geometry) a. Triangle b. Trapezoid isosceles tube
2	Kamandungan Lor/Plataran Keben (a place to store gamelan)	 	1. Count the number of objects (poles) 2. Equivalence 3. Symmetry magazines 4. Y-axis mirroring
3	Bangsal Pancaniti (placing the gunungan and other ubarampe hajat Dalem before being carried to the Gede Mosque.)		1. Recognize shapes (1D, 2D, and 3D geometry or non-geometry) a. Tube b. Rectangle 2. Count the number of objects a. Mast b. Fence 3. Measuring Length with units: a. standardized b. Not standardized
4	Bangsal Pancaniti (placing the gunungan and other ubarampe hajat Dalem		1. Measuring Length with units: a. standardized b. Not standardized

No	Building Name	Image	Math Value
	before being carried to the Gede Mosque.)		2. Perimeter and area of rectangular flat shapes 3. Count the number of objects (poles)
5	Regol Bangsal Pancaniti (gate)		1. Recognize shapes (1D, 2D, and 3D geometry or non-geometry) a. Circle b. Block c. Square d. Rectangle
6	Sri Manganti (dance practice/performance venue for visitors)	 	1. Count the number of objects (poles) 2. Calculating multiples 3. Measuring Length with units: a. standardized b. Not standardized 4. Calculate the perimeter of the building based on the distance between the first pole and the next pole with the number of existing poles. 5. Length Scale
7	Bangsal Manis (dining room for entertaining state guests)		1. Count the number of objects 2. Recognize shapes: a. Surveyors b. Nongeometri 3. Addition 4. Symmetry magazines

No	Building Name	Image	Math Value
8	Bangsal Manis (dining room for entertaining state guests)		1. Recognize shapes (1D, 2D, and 3D geometry or non-geometry) a. Circle b. Balok c. Triangle d. Rectangle 2. Count the number of stars and squares on the roof
9	Bangsal Manis (dining room for entertaining state guests)		1. Calculate the perimeter of square and rectangular flat shapes 2. Tiling 3. Addition
10	Bangsal Mandhalasana (the room of the musician who accompanies the performance)		1. Recognize shapes (1D, 2D, and 3D geometry or non-geometry) a. Triangle b. Rhombus c. Square d. Rectangle e. Quadrilateral 2. Count the number of objects 3. Addition 4. Measuring angles 5. Perimeter and area of flat shapes 6. Build a triangle

According to the Decree of the Head of the Education Standards, Curriculum, and Assessment Agency of the Ministry of Education, Culture, Research and Technology Number 008/H/KR/2022, which outlines learning outcomes across early childhood education, basic education levels, and secondary education within the independent curriculum, the learning outcomes vary by educational phase (Daeli et al., 2022). Furthermore, the architecture of Yogyakarta's Sultan Palace offers a rich resource for teaching measurement concepts across different elementary school phases (phase A, phase B, and phase C). Table 2, Table 3, and Table 4 illustrate how various aspects of the palace's architecture can be utilized to teach measurement material in alignment with the independent curriculum.

Table 2. Ethnomathematics Materials of Yogyakarta's Sultan Palace Architecture Phase A (Grades 1 and 2)

No	Elements	Topic Lesson Material
1	Numbers	1. counting numbers up to 10,000
		2. fraction
		3. decimal
		4. percent
2	Algebra	1. number patterns
		2. count back
3	Measurement	1. measure Length and weight with standard units
		2. area and volume with standard and non-standard units
4	Geometry	1. characteristics of flat shapes
5	Data and Opportunity Analysis	1. sort, compare, present, analyze data
		2. diagrams and tables

Table 3. Ethnomathematics Materials of Yogyakarta's Sultan Palace Architecture Phase B (Grades 3 and 4)

No	Element	Topic Lesson Material
1	Numbers	1. counting numbers up to 10,000
		2. fraction
		3. decimal
		4. percent
2	Algebra	1. number patterns
		2. count back
3	Measurement	1. measure Length and weight with standard units
		2. area and volume with standard and non-standard units
4	Geometry	1. characteristics of flat shapes
5	Data and Opportunity Analysis	1. sort, compare, present, and analyze data
		2. diagrams and tables

Table 4. Ethnomathematics Materials of Yogyakarta's Sultan Palace Architecture Phase C (Grades 5 and 6)

No	Element	Topic Lesson Material
1	Numbers	1. Numbers up to 1,000,000
		2. value of money
		3. LCM and GCD
		4. Calculate mixed fractions
		5. Pecahan decimal
2	Algebra	1. Reverse multiplication and division
		2. Mixed arithmetic operations
3	Measurement	1. Perimeter and area of flat shapes
		2. Time
		3. Angles
4	Geometry	1. Build space
		2. Scale
5	Data and Opportunity Analysis	1. Presentation data

Mathematical Ideas in the Context of the Architecture of Yogyakarta's Sultan Palace: Numbers and Basic Operations (Phase A Grades 1 and 2)

To facilitate the teaching of basic mathematical operations such as addition, subtraction, multiplication, and division, the architecture of Yogyakarta's Sultan Palace offers practical examples. By using simple data related to the palace's features, students can engage in meaningful math activities.

Sample Problem:

Box's ward (Bangsal Kotak) is built as a place to wait for dancers who will perform, the box ward has 8 pillars. If there are 3 Box wards (*Bangsal Kotak*) in the courtyard of Yogyakarta's Sultan Palace, how many pillars are there in total?

Answers:

Identify the information provided:

Each Box's ward (Bangsal Kotak)has 8 supporting pillars.

There are 3 Box wards (*Bangsal Kotak*) in the courtyard of Yogyakarta's Sultan Palace.

Determine the operations that need to be performed:

To find the total number of poles, we need to multiply the number of poles per ward by the number of wards.

Do the math:

Number of poles per ward: 8

Number of wards: 3

Total poles = number of poles per ward × number of wards

$$8 \times 3 = 24$$

or

$$8 + 8 + 8 = 24$$

Write down the answer:

So, the total number of poles is 24.

Mathematical Ideas in the Architectural Context of Yogyakarta's Palace: Measurement and Scale (Phase C Grades 5 and 6)

Activities performed:

Measuring Length and Width: (1) Use a simple floor plan of Yogyakarta Palace, (2) Ask students to measure the length and width of various buildings using a ruler, (3) Teach the concept of scale, for example 1 cm on the floor plan is equivalent to 3 meters in the real world.

Example:

Regol Bangsal Pancaniti has a very large gate in the shape. If the length of the gate in the plan is 3 cm and the width is 1.5 cm, what is the actual length and width of the gate of Bangsal Pancaniti?"

Identify the information provided:

Length of one gate in the plan: 3 cm

Width of one gate in the plan: 1.5 cm

Scale: $1 : 300$ (which means 1 cm in the plan is equivalent to 300 cm or 3 meters in the real world)

Determine the operations that need to be performed:

To find the actual length and width, we need to multiply the measurements on the plan by the scale.

Formula Actual Distance

$$\text{Actual Distance} = \text{Distance on Map} \times \text{Scale Factor}$$

Explanation

Distance on a Map is the distance measured on a map or plan (in units of a certain length, such as centimeters).

Scale Factor is a value that shows the ratio between the distance on the map and the actual distance. If the scale is given as 1, then the scale factor is x.

Answer:

Multiplying the measurements on the plan by the scale

Actual length:

Actual length = 3 cm × 300 = 900 cm = 9 meters

Actual length = 3 cm × 300 = 900 cm = 9meter

Actual width:

Actual width = 1,5 cm × 300 = 450 cm = 4,5 meter

Actual width = 1,5cm × 300 = 450 cm = 4,5 meter

The study's results can be formulated in alignment with the underlying concepts or hypotheses established. Prior research has shown compatibility with this study, particularly in discussions related to geometry. The methodology for selecting and validating mathematical lessons derived from the architectural features of Yogyakarta's Sultan Palace could include the following steps:

1. Literature Review and Descriptive Analysis
   Examine existing literature and identify potential mathematical concepts related to the architectural features of the Sultan Palace.
2. Expert Consultation
   Engage with experts in mathematics and architectural history to identify relevant mathematical concepts.
3. Direct Observation
   Collect data through direct observation of the architectural features to identify teachable mathematical concepts.
4. Curriculum Validation
   Ensure that the identified mathematical concepts align with the primary school educational curriculum.
5. Development and Testing of Learning Materials
   Develop and integrate mathematics learning materials based on the identified concepts, and test these materials for effectiveness.
6. Feedback Collection
   Gather feedback from educators and students to assess the effectiveness and relevance of the developed learning materials.

For adjustments and improvements in the proposed teaching approach using Yogyakarta's Sultan Palace architecture at the elementary school level, the following steps can be undertaken:

1. Development of Learning Materials
   Create mathematics learning materials integrated with concepts from Yogyakarta's Palace architecture, such as geometric patterns and proportion calculations.
2. Limited Trial
   Organize a simulated learning session or limited trial with a group of elementary school students to evaluate their responses to the new learning material and their understanding and application of the taught concepts.
3. Case Studies or Focus Groups

Conduct case studies or focus groups with students and teachers to gain in-depth insights into the teaching effectiveness. This may include direct observation, interviews, or structured questionnaires.

4. Evaluation of Learning Outcomes
   Assess students' learning achievements before and after using the learning materials derived from the Sultan Palace architecture, focusing on their ability to apply mathematical concepts in an architectural context.
5. Feedback Analysis
   Analyze feedback from educators and students to identify strengths, weaknesses, and areas for improvement in the learning materials.
6. Revision and Improvement
   Based on evaluation results and feedback, revise the mathematics learning materials to enhance their quality, including adjustments to content, teaching methods, or further development of existing materials.

Ethnomathematics related to Yogyakarta's Sultan Palace architecture holds significant potential for mathematics learning, particularly for elementary students. The palace's architecture can serve as a context for teaching two-dimensional and three-dimensional shapes, as well as area and perimeter concepts (Mauluah & Marsigit, 2019; Mauluah, 2022). An example lesson plan for Grade 5 might include:

1. Material Explanation
   Demonstrate how to measure the length and width of buildings or rooms in the Sultan Palace using a ruler, including a demonstration with photos or drawings of the palace.
2. Concept of Scale
   Explain the concept of scale on maps or plans of the Sultan Palace, using simple examples.
3. Project-Based Learning
   Task students with measuring the dimensions of buildings or rooms in the Sultan Palace using provided photos or drawings and calculate the actual size using the given scale.
4. Presentation
   Have students present their findings.
5. Reflection and Feedback
   Engage in reflection and gather feedback.

This research provides a detailed examination of how Yogyakarta's Sultan Palace architecture can be used as a learning medium. The study reveals that integrating local cultural elements into mathematics education can enhance students' understanding of mathematical concepts, such as numbers, and facilitate problem-solving in real-world contexts. It also fosters an appreciation for local culture and motivates students to learn and preserve their cultural heritage. The findings suggest that ethnomathematics learning, based on the Sultan Palace architecture, can effectively highlight geometric patterns, symmetry, and proportions, offering valuable mathematical learning opportunities.

The relevance and implementation of this study's results within the Independent Curriculum framework can be assessed based on how these findings integrate with mathematics education principles that emphasize contextualization and locality. The educational implications include enhanced student motivation, understanding, and appreciation of both mathematics and local cultural heritage. Additionally, this research aligns with previous studies, underscoring the importance of the ethnomathematics approach in mathematics education.

Conclusion

Ethnomathematics learning based on the architecture of Yogyakarta’s Sultan Palace, aligned with the learning outcomes of the Independent Curriculum for elementary school phases A, B, and C, can be effectively utilized to teach various mathematical concepts, including numbers, algebra, measurement, geometry, and data analysis and probability. The researcher recommends that future studies delve into the detailed aspects of Yogyakarta’s Sultan Palace architecture and explore its transformation into engaging and interactive learning materials for elementary school students.

Concrete suggestions include developing a mathematics curriculum that is more locally oriented, with enhanced integration of cultural elements into mathematics education. By emphasizing the direct connection between the architecture of the Yogyakarta Palace and mathematics instruction at the elementary level, this research aims to offer valuable insights for creating a more contextualized and impactful mathematics education framework.

However, this research is constrained by the challenge of translating intricate mathematical elements observed in ancient architecture into contemporary educational curricula. Thus, careful consideration must be given to the educational relevance and feasibility of such integrations.

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Conflicts of Interest

The author declares no conflict of interest regarding the publication of this manuscript. Furthermore, all ethical issues, including plagiarism, data falsification, multiple submissions, and redundancy, have been rigorously addressed by the author.

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