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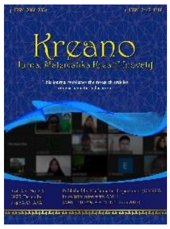

Preliminary Design of an Outdoor Mathematics Learning Model through Math Trailsin the Cultural Tourism Context of Putri Pinang Masak Park Jambi

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Abstract

In Indonesia, mathematical learning designs that integrate outdoor learning with the context of local tourism are still very limited, despite the authentic opportunities such environments provide for relating mathematics to real life. The objective of this study is to design an outdoor learning-based mathematics learning model using the Indonesian Realistic Mathematics Education (PMRI) approach, in the context of the Putri Pinang Masak Park cultural tourism destination in the city of Jambi. The approach adopted was design research at the preliminary design stage, which encompassed curriculum analysis, exploration of the mathematical context at the location, and development of a math trail blueprint. The results of this study will show that the tourist environment provides a rich context for geometry, measurement, and proportional reasoning, thereby rendering learning more meaningful, mindful, and joyful. This design contributes to the development of contextual pedagogy and forms the basis for the prototyping and validation stages. Further research is necessary to ascertain the effectiveness of the design in learning practice.

Keywords: Outdoor Learning; PMRI; Math Trail; Design Research; Cultural Tourism

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Abstrak

Desain pembelajaran matematika di Indonesia yang telah mengintegrasikan outdoor learning dengan konteks pariwisata lokal masih sangat minim, sedangkan lingkungan tersebut menyediakan peluang yang autentik untuk mengaitkan matematika dengan kehidupan nyata. Tujuan dari penelitian adalah merancang model pembelajaran matematika berbasis outdoor learning dengan pendekatan Pendidikan Matematika Realistik Indonesia (PMRI), yang dikontekstualisasikan pada destinasi wisata budaya Putri Pinang Masak Park di Kota Jambi. Metode yang digunakan design research pada tahap preliminary design, yang memuat analisis kurikulum, eksplorasi konteks matematis di lokasi, serta pengembangan blueprint math trail. Hasil dari penelitian ini akan menunjukkan bahwa lingkungan wisata menyediakan konteks kaya untuk geometri, pengukuran, serta penalaran proporsional sehingga pembelajaran lebih meaningful, mindful, and joyfull. Desain ini memberikan kontribusi pada pengembangan pedagogi kontekstual dan menjadi dasar bagi tahapan prototyping serta validasi. Penelitian selanjutnya dapat menguji efektivitas desain dalam praktik pembelajaran.

INTRODUCTION

Mathematics learning at the junior high school level continues to encounter obstacles, particularly in students' inadequate capacity to relate mathematical concepts with real-world circumstances. Several studies have indicated that children often rely on procedural understanding and struggle to use geometry, measurement, and proportional reasoning skills when confronted with authentic scenarios (Cahyono, Sukestiyarno, Asikin, Miftahudin, et al., 2020). In formal education in Indonesia, mathematics learning ideally is not only directed at understanding concepts and calculation processes but also focuses on mathematical literacy, problem-solving abilities, and mathematical communication skills (Rahayu & Putri, 2021). The independent curriculum emphasizes that learning should focus on developing the real competencies students need. This orientation is reflected in the mathematics learning outcomes (CP) of phase D at the junior high school level, which not only target conceptual understanding but also encourage students to interpret and apply mathematics in everyday situations. Within this framework, Elements of geometry and measurement an essential role as a learning space where students explore various shape, determine area, perimeter, and volume of both flat and spatial shapes, use congruence and symmetry, understand the Pythagorean theorem, and relate measurement to scale in real contexts (Fauzi & Arisetyawan, 2020; Susanti et al., 2023; Wati & Nurcahyo, 2023). Normatively, learning mathematics in junior high school must be able to prepare students to not only master concepts but also be able to apply them in everyday life and the socio-cultural environment around students.

The facts in the field show that there is a gap between the ideal conditions to be designed in the curriculum and the reality of learning in schools. Many studies describe that mathematics learning in Indonesia is still dominated by conventional approaches that are teacher-centered, focused on memorizing formulas, and lack of integration with the real context around students (Zulkardi, 2025; Zulkardi et al., 2019). Initial observations of researchers in Jambi City junior high schools showed that teachers still used textbooks as a source and routine problem exercises in explaining geometry and measurement concepts. Students can do area, perimeter, or volume calculation problems but have difficulty when asked to connect concepts with real objects around students. When students were asked to estimate the height of a building, calculate the volume of a water container, and determine the diameter of a circle with simple measurements, students showed limitations in using mathematical concepts as a tool to understand real-world applications.

This condition shows that there is a gap between the ideal goal of learning mathematics in the independent curriculum and the practice of ongoing learning. It should be in accordance with the paradigm of modern mathematics education, students who learn mathematics from meaningful contextual experiences, not merely through abstract symbols and procedures (Freudenthal 1992, gravemeijer 1994) this is in line with the government program, namely deep learning, namely meaningful, mindful, and joyful learning activities. Vygotsky (1978) emphasized the importance of social interaction and cultural context in building knowledge, Bruner (1964) said that learning should move from the enactive stage ((Brown, 2021; Kedikli & Katrancı, 2024)direct experience), iconic (using visual representations, to symbolic which uses abstract symbols . This ideal condition has not been fully implemented in the practice of learning mathematics in junior high schools / MTs.

The gap between ideal and reality shows the need for innovation in mathematics learning design. An alternative that can be used as an option is outdoor learning as a learning model. Outdoor learning places the environment around students as a place to learn, where students interact directly with real objects to build concepts (Nugraha et al., 2023). This model can be a more active, collaborative, and meaningful learning because students are not only dealing with abstract symbols but also doing exploration, measurement, and discussion activities based on real experiences. This is in accordance with Thorndike's 1914 view of connectionism, that learning will be stronger when the stimulus has a direct relationship with the response (Doni et al., 2024).

In an effort to ensure a directed learning experience and in accordance with pedagogical principles, outdoor learning in this study is combined with the Indonesian Realistic Mathematics Education (PMRI) approach. PMRI which stems from Freudenthal's Realistic Mathematics Education (RME) emphasizes that mathematics should be taught through real contexts, guided reinvention, and horizontal and vertical mathematization processes (Zulkardi, 2002). In this PMRI approach, students are invited to rediscover mathematical concepts through contextual problems that are relevant to their lives. Vygotsky (1978) emphasized the importance of social and cultural contexts as zones of proximal development that facilitate knowledge construction (Liu, 2024; Nardo, 2021). Bruner (1964) added that effective learning occurs when students go through the stages of enactive (direct experience), iconic (using representations), to symbolic (abstracting) (Quane, 2024; J. Zhou, 2020; X. Zhou, 2024). The connection between the outdoor learning model and the PMRI approach allows mathematics learning to be more contextual, meaningful, and in line with the cognitive development characteristics of junior high school students.

Outdoor learning, strongly aligned with PMRI concepts, offers significant possibilities for children to interact directly with tangible items and real-world situations in their environment. This approach identifies Math Trails as a pertinent and efficacious strategy. A Math Trail converts designated locations into a sequence of "mathematical task posts," directing students to investigate, quantify, discern trends, and resolve issues in real-world scenarios. Students learn how to use mathematics to make sense of common things through these structured exercises, which makes the learning process more relevant, engaging, and fun. This method aligns closely with PMRI's focus on real-world settings and advanced mathematization.

In this perspective, the local environment of Jambi City offers a significant opportunity to apply outdoor learning by leveraging its abundant tourism potential. Putri Pinang Masak Park is a notable green park and urban landmark, showcasing several physical artifacts of historical and mathematical importance. Features include the temple-like pillars, the Putri Pinang Masak boat, the Ka'bah-shaped prayer room, the photo-spot stairway, and the prominent city-symbol gong can be converted into Math Trail task stations, enabling students to participate in practical arithmetic exercises.

For example, students might assess the height of a pillar by tallying the bricks arranged along its structure, ascertain the circumference of a circular feature by analyzing the tiled patterns surrounding the pool, or gauge the pool's depth at several locations to compute its average depth. These exercises enable students to immediately engage with the practical application of geometry and measurement in a real-world context, enhancing comprehension and rendering mathematics more significant, captivating, and enjoyable.

Previous research supports the effectiveness of this strategy. In accordance with research (Fessakis et al., 2018)found that the use of math trail improves mathematical literacy and problem-solving skills. (Jablonski, 2022)in Germany showed that outdoor learning based on the surrounding location can strengthen the relationship between mathematical concepts and students' real life. Indonesian research (Zulkardi & Putri, 2019)proved that local cultural contexts in PMRI, such as in the context of batik and traditional markets, can improve students' conceptual understanding. But research specifically using cultural tourism context as the basis of mathematics learning design is still limited. This research comes to fill the gap and design mathematics learning based on outdoor learning as a model and PMRI as an approach, namely the pedagogical foundation in Putri Pinang masak park Jambi.

The significance of this work can be comprehended from both theoretical and practical viewpoints. Theoretically, through integrating PMRI to the field of educational tourism, this study expands its application. In doing so, it transcends conventional everyday contexts such as traditional games or market activities and integrates learning into cultural spaces that possess historical and mathematical significance. This study provides a learning design that junior high school teachers can reference for applying the Independent Curriculum in a more contextual, meaningful, and culturally relevant manner. The Math Trail created in this research aims to reconcile the disparity between the optimal expectations of geometry and measurement learning outcomes and the actual challenges encountered in classroom practice, while concurrently promoting the Pancasila Student Profile, especially in cultivating critical and creative thinking and an appreciation for local culture.

This research aims to develop the inaugural prototype of an outdoor mathematics learning pathway a Math Trail comprising a series of contextual exercises located in Putri Pinang Masak Park. More specifically, this study wants to find out how to make a Math Trail that is useful for outdoor math learning in a cultural tourism setting; which types of contextual tasks can use real objects in the park to demonstrate geometry and measurement; and how the resulting design aligns with the PMRI principles and the Independent Curriculum's requirements. This design initiative aims to provide pedagogical insights and practical guidance pertinent to modern mathematics teaching.

METHOD

This research uses a design research method with the type of development studies. According to (Akker et al., 2006), this design research consists of three main stages, namely preliminary design, prototyping phase, and retrospective analysis. This article focuses on the first stage, namely preliminary design, which aims to produce an initial design of outdoor learning-based mathematics learning through math trail in Jambi City. This approach was chosen because it is in accordance with the characteristics of PMRI which emphasizes contextual starting points in learning (Zulkardi, 2002), provides space for interactive and real context-based design development, and is able to produce a design product in the form of an initial prototype of a math trail that can be tested in the next stage.

The subjects of this research were junior high school students in Grade IX, selected in accordance with the mathematics content scope, which covers geometry, comparison, scale, and measurement. The study involved participants throughout three stages of the design research process: three students and one mathematics teacher in the one-to-one stage, six students in the small group stage, and twenty-four students, along with six mathematics teachers, in the field test stage. The contextual setting of the investigation was Putri Pinang Masak Park in Jambi City. This location was chosen due to its historical and cultural significance, as well as the diversity of real objects that could serve as Math Trail task posts, such as the temple-like pillars, the Ka'bah-shaped prayer room, the Putri Pinang Masak boat, the black-and-white staircase, and the iconic Jambi city gong.

The research procedure at the preliminary design stage was carried out with the following stages: curriculum and competency analysis, local context analysis, math activity formula, preparation of initial prototype of math trail, and self evaluation. The research instruments used in the preliminary design stage were field observation sheets used to record the mathematical context in tourist sites, curriculum analysis documents to replace tourist objects with basic mathematics competencies, and self evaluation to assess aspects of suitability, clarity, and feasibility of math trail design. The data analysis in this research is with a descriptive qualitative approach, namely the results of field observations are analyzed to find opportunities for contextualization of mathematics, curriculum analysis is used to compile the linkage between tourist objects and learning outcomes.The output at the preliminary design stage is in the form of a mat trail route map at Putri Pinang Masak Park, the design of mathematical activities at each post, and teacher notes.

This research yielded three key outputs as an initial Math Trail prototype: a Math Trail route map, mathematical work sheets, and teacher notes. The route map provides the trip route and the location of each task station in Putri Pinang Masak Park as a guide for outdoor learning implementation. Mathematical task sheets contain contextual exercises derived from real things at the place, including task descriptions, directions, and mathematical reasoning needs based on geometric, measurement, comparison, and scale competences. Meanwhile, the teacher's notes give implementation instructions, explanations of learning objectives, and ways for directing students to ensure the learning process is effective and conforms with the concepts of PMRI. These three components comprise Prototype 1 as the basis for the next development step.

RESULT AND DISCUSSION

Results

The research focuses on the preliminary design stage, which focuses on the initial design of outdoor learning-based mathematics learning with the PMRI approach. The location of this research is Putri Pinang masak park in Jambi, a cultural tourist spot that contains historical values and has physical objects that contain mathematical potential. The learning design is expected to be a blueprint before going to the prototype and implementation stages.

Curriculum analysis is the first step in this study, which examines the junior high school (SMP) mathematics curriculum, namely the independent curriculum to find learning outcomes that are relevant to the outdoor learning context. The analysis shows that some learning outcomes that can be combined with the context of Putri Pinang masak park tour more specifically are seen in Table 1 and Table 2.

The gap analysis in curriculum analysis is that the independent curriculum has emphasized measurement and geometry based on abstract concepts in schools, but it is still rare to use real contexts and local culture as learning resources, and the design of a math trail with measurement activities in Putri Pinang masak park bridges this research gap, so that learning outcomes can be achieved through learning based on real experiences. The implication on the learning design that will be designed is that student activities when measuring objects such as temple pillars, prayer room windows, stairs, and circles directly integrate CP geometry and measurement. Students not only understand and apply formulas but also learn to use real units, proportions, congruence, and spatial relationships. This is in accordance with the principles of PMRI, namely from real context to concrete models and concept formalization. The results of the curriculum analysis confirmed that integration with the tourism context allows for more contextualized mathematics learning without leaving the demands of national learning outcomes.

Table 1. Junior High School Learning Outcomes

Elements	Learning Outcomes (CP)
Geometry and Measurement	1. Determine area, perimeter, and volume of flat and spatial shapes. 2. Relate changes in length, area, and volume to scale factors. 3. Explain and use similarity and congruence in solving problems. 4. Apply the Pythagorean theorem to real situations 5. Determine the circumference, area of a circle, and the relationship between diameter and radius 6. Use indirect measurement in determining height or distance with the help of comparison.

Table 2. Relevance to outdoor learning activities (Math Trail)

Student Activity	Related geometry and measurement concepts	Corresponding CP
Students measure the height and width of the window, for the height of the window students measure from the bricks arranged beside the window.	Indirect measurement of length, the relationship between small units (bricks and the size of large objects).	Use comparison and congruence in measuring length and height of real objects.
Students measure the depth of the pool at 5 different points to ensure that the height of the pool is not the same Next, students measure the diameter of the pool by looking at the length of the tiles arranged next to the pool along the diameter of the pool.	Volume and depth of a space (tube), diameter and area of a circle.	Determining the size of spatial figures and understanding the relationship between diameter, radius, and area of a circle
Students measure the height and width of the temple pillars by measuring the height of the bricks that make up the temple pillars and counting how many bricks are arranged as high as the temple.	Consanguinity, length measurement, surface area of spatial figures.	Determining the size of a space through indirect measurement and proportion.
Students measure the height of the stairs by measuring the unit height of the tiles that cover the surface of the stairs.	Gradient/slope, right triangles, and the concept of comparison	Apply the Pythagorean theorem and comparison to determine the height of a real figure.
Students measure the diameter of a circle by counting the tiles arranged on the circle.	Circles: circumference, diameter, radius, and area	Determine the circumference and area of a circle using real measurements

Field observations were conducted to identify real objects in Putri Pinang masak park that can serve as tasks on the math trail. The results show that there are five potential points in Putri Pinang masak park, namely the muaro jambi temple pillar can be used to calculate the height of the pillar made of bricks, the Putri Pinang masak boat pool used to measure the volume of the pool, the black and white stairs used for the context of the gradient and the relationship between the height and length of the inclined plane, the ka'bah mushola window to measure the window area around the mushola wall, and the gong on the logo of the city of Jambi in the park made like a floor used to measure the floor area that forms a gong like a circle. Each task point is photographed by first activating the GPS, then taking data on each object by measuring and recording the data needed to produce a draft question.

Based on the curriculum analysis and field exploration, a math trail blueprint was developed. The blueprint contains descriptions of the stations, math activities, and targeted competencies, along with the activities that have been designed. It can be seen in Table 3.

Table 3. Math Activities

Post Name	Photo	Activity
Kaaba Musholah		Students measure the height and width of the window, for the height of the window students measure from the bricks arranged next to the window. Learning Outcomes: students are able to explain the effect of changes in length, area, or volume and understand the relationship between flat and spatial shapes.
Boat in the Pond		Students measure the depth of the pool at 5 different points to ensure that the height of the pool is not the same Furthermore, students measure the diameter of the pool by looking at the length of the tiles arranged next to the pool along the diameter of the pool. Learning Outcomes: students are able to determine the surface area and volume of a space, able to collect, present, and analyze measurement data (mean), and explain the area of a circle and diameter
Temple Pillar		Students measure the height and width of the temple pillar by measuring the height of the bricks that make up the temple pillar and counting how many bricks are arranged as high as the temple. Learning Outcomes: students are able to explain how to calculate the surface area and volume of spatial figures, use congruence, and scale factor in determining the size of real spatial figures.
Black and White Staircase		Students measure the height of the staircase by measuring the unit height of the tiles covering the staircase surface. Learning Outcomes: students are able to use the concepts of ratio, proposition, and scale in calculating the total height of a building based on repetition of the smallest unit.
Gong Floor		Students measure the diameter of a circle by counting the tiles arranged in the circle. Learning Outcomes: students are able to explain how to determine the area of a circle, diameter length, circumference of a circle, as well as use the relay between radius, diameter, and circumference.

The resulting blueprint then proceeds trough a self-evaluation stage, which is an internal assessment performed by the researcher to evaluate the quality of the design that has been generated. The self-evaluation method includes issues such as the suitability of the content with the curriculum utilized, the relevance of the context to students' daily routines, the clarity of instructions for each activity, and the practicality of the design in outdoor learning situations. The review results indicate that the design is considered feasible, but there are some notes: the language used in some questions needs clarification as there are still ambiguous words, the estimated time for each station needs to be added, and the suitability and feasibility of the images used at each station need to be reviewed.

The research results at the preliminary design stage demonstrate that Putri Pinang Masak Park can be a rich source of learning for mathematics, both curriculum-wise and contextually relevant.

Discussion

The findings of this study demonstrate that mathematics learning can be innovatively structured through the merging of outdoor learning as a pedagogical model and PMRI as a contextual approach. By utilizing appropriate artifacts in a cultural tourist setting, students are encouraged to engage with mathematics in a manner that is contextual, authentic, and linked with their lived experiences. This coincides with the approach of Realistic Mathematics Education (Freudenthal, 1991; Gravemeijer & Cobb, 2006), which stresses guided reinvention through meaningful scenarios. The Math Trail established in this study gives opportunities for students to mathematize real objects such as pillars, staircases, and symbolic structures thereby increasing both conceptual knowledge and spatial thinking.

These findings resonate with international studies, such as Fessakis et al. (2018), who built a Math Trail in natural areas assisted by digital gadgets (Cahyono, Sukestiyarno, Asikin, & ..., 2020; Cahyono & Ludwig, 2019). Both studies underscore the relevance of outdoor learning in developing discovery, inquiry, and authentic mathematical reasoning. However, the present study varies in its integration of cultural tourism as the principal background rather than natural habitats, bringing a new layer of cultural and historical relevance to mathematical activities. In addition, while prior studies mostly focused on boosting engagement or digital-supported exploration, the present research embeds PMRI concepts to ensure students are not only performing tasks but are actively reinventing mathematical ideas through local cultural settings. This reinforces the enhanced pedagogical advantage of placing outdoor learning within a formal design research framework (Cochrane et al., 2023; Cochrane & Munn, 2020; Rüütmann, 2019).

In the Indonesian context, various research have employed local culture inside mathematics education such as batik patterns, traditional markets, local games, and woven crafts (Sari et al., 2021; Zulkardi et al., 2019). However, most of these research use cultural contexts in classroom settings rather than outside locations. The present work fills this gap by proving that cultural and historical tourism locations can serve as rich mathematical contexts when translated into systematic Math Trail designs. This emphasizes a new avenue in PMRI-based research: extending local settings beyond classroom items into real-world cultural areas with actual mathematical structures (Hendriana et al., 2025; Nabila et al., 2024; Putra et al., 2023).

The uniqueness of this work rests in three primary aspects. First, it mixes cultural tourism with outdoor learning and PMRI, widening the terrain of contextual mathematics education in Indonesia. Second, it offers a systematically developed Math Trail blueprint that is ready for subsequent prototyping inside the design research cycle. Third, it contributes to the worldwide debate by showing that tourism-based learning environments can serve as powerful contexts for mathematization, spatial thinking, and guided reinvention. This validates existing demands in the literature for more diversified, authentic, and place-based mathematics learning experiences (Ariyanti et al., 2023; Lusiana, 2025; Sukasno et al., 2024).

The theoretical contribution of this research reveals that PMRI can be expanded beyond ordinary activities into culturally and historically rich tourism situations, which broadens the range of authentic materials available for meaningful learning. Practically, the study presents a Math Trail template that can be changed by instructors in various settings, facilitating the implementation of the Independent Curriculum through contextual, inquiry-driven learning. This blueprint can serve as a reference for building comparable learning experiences in other parks, heritage sites, or local tourism regions, thereby pushing educators to exploit their surroundings more imaginatively as a mathematical learning space.

Implication of Research

The ramifications of this research cover practical, theoretical, and policy dimensions. Practically, the research results provide recommendations for teachers and schools to exploit the tourism environment around children as a living classroom that can boost their mathematical learning experiences trough authentic activities. The resulting Blueprint Math Trail can serve as a model for constructing contextual assignments, developing outdoor learning settings, and incorporating real objects to increase students' reasoning, measurement, and spatial literacy skills. Schools are also urged to work with local tourism site operators so that outdoor learning activities can be carried out in a structured, safe, and sustainable manner.

Theoretically, this research enhances the development of PMRI by proving that its concepts are not only relevant to regular classroom contexts but can also be effectively utilized in cultural tourist settings. Integrating PMRI with outdoor learning in cultural settings gives new paths for exploring how directed reinvention, mathematization, and context-based learning processes might occur in dynamic outdoor situations. This research enriches the theoretical framework of context-based mathematics education and emphasizes the promise of place-based mathematics education in Indonesia.

From a policy viewpoint, this research suggests the need for policy assistance to enhance cross-sector collaboration between schools, local governments, and tourism site management. This relationship is vital in providing secure learning access, encouraging the use of tourist sites as learning resources, and establishing unique learning programs based on local culture. Policies also need to support cultural and tourism integration as a setting for learning mathematics to increase mathematical literacy while also boosting students' cultural awareness.

Moving forward, further study is needed to assess the practicality and possible impacts of the Math Trail prototype in real-world deployment with students, including examining the learning process, student engagement, and the development of conceptual understanding.

Limitation

This study has various limitations that need to be acknowledged. First, the research only covered the early design stage and was still not through to the implementation stage with students, therefore the feasibility, student response, and possible learning impacts of the Math Trail design could not be examined. Second, the tourist area utilized is limited to one location, namely Putri Pinang Masak Park, so generalizing the design to other tourist locations—whether cultural or natural—is still constrained. Third, this research has not directly involved participants in the field implementation, so variations in student planning, group dynamics, and potential learning challenges have not been empirically seen. Fourth, external elements such as weather conditions, crowd levels, and location accessibility have not been investigated, even tho these aspects have the potential to impact the practicability and sustainability of outdoor learning.

To address these constraints, future study has to extend this design to the one-to-one, small group, and field test stages in order to assess its feasibility, acceptance, and possible impact on students' learning processes. Further research is also advised to widen the context by adapting Math Trails to numerous tourist places with different cultural and natural aspects, making the concept more adaptive and usable. Additionally, real-world implementation will allow researchers to examine student engagement, teacher facilitation tactics, and environmental obstacles, like weather and visitor density, and optimize the design for wider applicability. Thru these steps, the Math Trail prototype could potentially be thoroughly validated and developed into a scalable outdoor learning approach.

CONCLUSION

The purpose of this study is to design outdoor-based mathematics learning that is relevant and contextual to the tourism potential of Jambi City. The conclusion of this preliminary stage is that the math trail with the PMRI approach at Putri Pinang Masak Park produces a learning blueprint that is clearly mapped out in five posts and is closely related to the learning outcomes of geometry, measurement, scale comparison, and the Pythagorean Theorem. It is therefore suggested that the activities of observing, measuring, and model building proceed from a real context to the formulation of concepts. The relevance of tourism and the potential for meaningful, mindful, and joyful learning. In the theoretical domain, this design has the potential to extend the application of PMRI to the context of cultural tourism, with authentic learning resource utilisation as a fundamental element. In practical terms, this research provides a prototype model that can be adapted by researchers or teachers to be integrated into the local context in lesson plans and authentic assessments.

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