Implementing the Realistic Mathematics Education (RME) Approach to Three-Dimensional Shapes Characteristics using Traditional Blitar Souvenirs in Elementary Schools

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Abstract: The importance of the right approach to mathematics learning. Many students believe that mathematics is complicated to learn because many mathematics teachers teach abstractly. This research is qualitative descriptive research that uses Graveimeiijeir's design research method. This research aims to prove that the hypothesis that has been written in the hypothetical learning trajectory or HLT (Hypothetical Learning Trajectory) is correct and how it impacts students' understanding of the material on the characteristics of three-dimensional shapes using traditional Blitar souvenir media and LKPD, which function as a guide to student activities. This research was conducted at SDN Lidah Kulon IV in class 5B. The research subjects were five students, three men and two women. The research stages carried out were planning, implementation in the classroom, and data analysis. This research shows that learning activities using the RME approach are based on the stages of the iceberg theory. This stage consists of real-world situations, models that describe problem situations (models of), models for solving problems (models for), and formal mathematical stages. Using traditional Blitar souvenir media, this stage can help students understand material about the characteristics of three-dimensional shapes.

Abstrak: Pentingnya pendekatan yang tepat untuk pembelajaran matematika. Banyak peserta didik percaya bahwa matematika sulit untuk dipelajari, hal ini terjadi karena banyak guru matematika mengajar secara abstrak. Penelitian ini adalah penelitian deskriptif kualitatif yang menggunakan metode penelitian desain milik Graveimeiijeir. Penelitian ini bertujuan untuk membuktikan bahwa hipotesis yang telah ditulis dalam lintasan pembelajaran hipotetis atau HLT (*Hypothetical Learning Trajectory*) benar dan bagaimana hal itu berdampak pada pemahaman peserta didik tentang materi ciri-ciri bangun ruang menggunakan media oleh-oleh khas Blitar dan LKPD, yang berfungsi sebagai pedoman kegiatan peserta didik. Penelitian ini dilakukan di SDN Lidah Kulon IV pada kelas 5B. Subjek penelitian adalah 5 peserta didik dengan 3 laki-laki dan 2 perempuan. Tahapan penelitian yang dilakukan yaitu perencanaan, pelaksanaan di dalam kelas, dan analisis data. Penelitian ini menunjukkan bahwa aktivitas pembelajaran dengan pendekatan pendekatan RME berdasarkan tahapan teori gunung es. Tahapan ini terdiri dari situasi dunia nyata (*situations*), model yang menggambarkan situasi masalah (*models of*), model untuk menyelesaikan masalah (*models for*), dan tahapan matematika formal. Dengan menggunakan media oleh-oleh khas Blitar, tahapan ini dapat membantu siswa memahami materi tentang ciri-ciri bangun ruang.

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A. Introduction

Education is one of the most significant parts of human life because it is a continuous process. Education will aid human development (Sariani et al., 2023). As a result, education is a top priority in many countries' development plans. As in Indonesia, the goal is to increase both knowledge and abilities. Education in Indonesia might improve in numerous ways.

Elementary school education is an important level of education that should be considered. Widodo (2019) claims that elementary school covers all disciplines. One of them is related to math. The human need to foresee, organize, and organize life in the future drives the advancement of mathematics. Teachers must be able to assess students' learning challenges in all disciplines. Each pupil must have unique qualities. According to Permatasari (2021), mathematics is among students' most despised topics. This is because mathematics is extremely abstract if not taught correctly.

Mathematics is one of the most important science topics to teach students. This is because mathematics may help students think, communicate effectively, and understand how to solve issues (Paroqi et al., 2020). Many students need help answering problems because they assume mathematics is a tricky topic. However, mathematics is not limited to one discipline. This makes kids unwilling to attempt to answer math difficulties.

In education, development theory is highly significant. Knowledge of cognitive development is an important topic of discussion in development theory (Agusdianita et al., 2021). This component is critical because it can facilitate the growth of other aspects. Piaget's cognitive theory is one of the best-known developmental theories. According Marinda (2020), According to Andreas, elementary school students reason at a concrete operational cognitive level. This suggests that students are learning to reason. They do, however, require assistance with real-world objects. Teachers must create a learning environment in which students can gain direct experience. This will help students sensibly understand mathematical concepts.

Many students dislike mathematics even though it is an important subject in education. As a result, hard work is critical to achieve learning objectives. When integrating mathematics into everyday issues, students must be taught to think critically, logically, and imaginatively (Andriani et al., 2023). This will prepare students to solve problems in their own life. Teachers must use caution while selecting a learning technique appropriate for the topic to be taught, considering present conditions.

Many elementary schools continue to teach mathematics traditionally, emphasizing memorizing formulas and solving abstract problems (Purwanto, 2024). This technique emphasizes teaching mathematical ideas that are not directly related to real-world events that students encounter daily. As a result, many students struggle to grasp mathematical concepts deeply because they cannot connect them to their real-world experiences. Without a mathematically realistic method, students frequently learn mathematics in a rigid environment that does not apply to real-life situations (Jehadus et al., 2024). They are taught to solve problems using procedural processes without understanding "why" or "how" the

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concepts relate to their world. This leads to student's comprehension, enthusiasm, and drive to learn mathematics (Septiana et al., 2022).

The RME (Realistic Mathematics Education) approach is a mathematics learning paradigm that can help students develop their creative thinking abilities (Ashari et al., 2023). This strategy blends math instruction with students' personal experiences. In this concept, the teacher's only responsibility is to assist students in constructively processing information. RME, as a learning model implemented with physical media, can assist students in applying abstract knowledge to real-life situations (Zulfa et al., 2023). In other words, RME can help students acquire their knowledge through exercises based on real-world situations. This strategy is one option to address some of the issues raised above.

The RME approach focuses on how students learn mathematics and engage in classroom activities (Nuraina et al., 2021). To accomplish this purpose, a learning trajectory is required. Historical Learning Trajectory, or HLT, is a learning approach that encourages students to engage in various specific activities to understand the content being taught (Prismayadi & Mariana, 2022). HLT is a hypothesis or prediction derived from students' learning experiences (Fakhrezi et al., 2023). Mathematics learning is projected to be made easier and more student-centred by tying it to the RME approach supported by HLT. Students can also design their own learning experiences.

Based on the challenges encountered at SDN Lidah Kulon IV, students needed help defining three-dimensional shapes' properties appropriately. Students only assess the properties of three-dimensional shapes, such as flat figures. They need to find out which portions are referenced. They only highlight a few incorrect traits. Field studies demonstrate that even if students do not have constructive experience in class, they can memorize the subject knowledge (Arisetyawan et al., 2014). Differential student traits and the material's difficulty level must influence classroom learning. Thus, learning must offer students with a strong comprehension.

Furthermore, many elementary schools must incorporate local cultural themes into their mathematical instruction (Amalia et al., 2024). Culture plays a vital role in students' daily lives and can provide a rich context for presenting mathematical concepts. When mathematics learning is not culturally integrated, students miss out on understanding mathematics as part of their daily experiences, which are influenced by the surrounding community's ways of thinking, traditions, and practices (Muyassaroh & Dewi, 2021). For example, mathematical principles like measurement, patterns, and symmetry might be conveyed via traditional art, local sports, or ordinary activities in their society.

A lack of a mathematically realistic approach and cultural integration in mathematics education create a significant divide. Students understand mathematical concepts in depth and believe mathematics is relevant to their lives. This makes mathematics instruction feel isolated and non-contextual, resulting in poor student learning outcomes and a decline in their enthusiasm for mathematics sessions (Wiryanto et al., 2024).

In prior studies, Diniyati et al (2022) researched "Ethnomathematics: Mathematical Concepts in Lebaran Cakes". The study examined the mathematical concepts included in

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Lebaran Cakes—shapes of hemispherical, cuboid, and rectangular three-dimensional shapes (Zulfa et al., 2023). There needs to be an explanation about incorporating ethnomathematics-based learning into the classroom. As a result, this study is novel in that it uses thematics-based learning in Blitar souvenirs and HLT to teach students how to discern spatial form qualities. This study will make mathematics learning more enjoyable and understandable.

The purpose of this study is to describe the design of mathematics learning activities using the RME approach and ethnomathematics, in general, using the learning trajectory hypothesis, or HLT (Hypothetical Learning Trajectory), with a focus on the characteristics of spatial structures using Blitar's traditional souvenir culture.

B. Method

This qualitative descriptive study uses a design research method (*Design research method*) (Adlini et al., 2022). The research subjects were students from class 5B at SDN Lidah Kulon IV. There are 27 students in this class. The research subjects are one of the class groupings. The number of individuals is five, including three males and two females. This study gathered data from various classroom activities, including picture documentation, videos, interviews, and direct observation of student activities involving identifying and exploring spatial form attributes. This research was carried out using Blitar souvenirs as learning materials. The souvenirs are used to facilitate students' contextual understanding of the forms of three-dimensional shapes. This data collection process allows researchers to get an in-depth picture of students' understanding of three-dimensional shapes through a fundamental object-based approach from the local area, which is expected to increase student engagement in mathematics learning.

The research stages correspond to the research design stages, according to Sukirwan et al (2022), which begin with research preparation activities and initial research design with a process in the form of making LKPD and HLT, followed by the implementation of the experimental design that has been made by conducting LKPD and HLT experiments in the classroom, and the last is the activity of analyzing data obtained from the stages that have been carried out previously, namely data from student LKPD, observation, The researcher's LKPD intends to assess students' cognitive abilities at level C4, especially concluding, as well as psychomotor characteristics at level P5, determining. In this study, the results of the classroom experiment will be described in detail.

The second stage of this investigation involved experimenting in the classroom. At this point, the intended LKPD and HLT were tested in class 5B. This investigation involves observing the learning process, student interactions with LKPD, and answering HLT-planned activities. LKPD is a tool for exploring students' comprehension of spatial form qualities, whereas HLT is a guide that anticipates students' learning trajectories based on their reactions to the teacher's stimuli. In this experiment, photos of Blitar souvenirs are utilized as contextual learning media to assist students in developing a mathematical understanding of three-dimensional shapes.

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The final step is to analyze the data obtained during the experiment. Data were gathered via the results of students' work on LKPD, observations of student interactions during the learning process, and interviews to better understand students' opinions on the learning they engaged in. The investigation was carried out to determine the efficacy of LKPD in increasing students' cognitive understanding at level C4 and psychomotor abilities at level P5. Observation data were also utilized to assess how HLT aids the learning process and how well learning predictions in HLT correspond to students' behaviours in the field.

This study examined HLT (Hypothetical Learning Trajectory) in relation to three-dimensional shape features. The activity was carried out by showing students photographs of typical Blitar souvenirs as a learning medium that may be used to create mathematical knowledge. The development of HLT is based on literature reviews, existing research findings, and an examination of students' challenges and impediments when learning in the classroom. The HLT design findings are then displayed in an HLT table, which includes activities carried out by the teacher, scenarios based on iceberg analysis poured into LKPD, and estimated activities carried out by students in response to the teacher's stimulus.

The results of the experiments done in class will be described descriptively, including an examination of the efficiency of LKPD in improving student's grasp of the features of spatial forms and the amount to which HLT serves as a guide in the learning process.

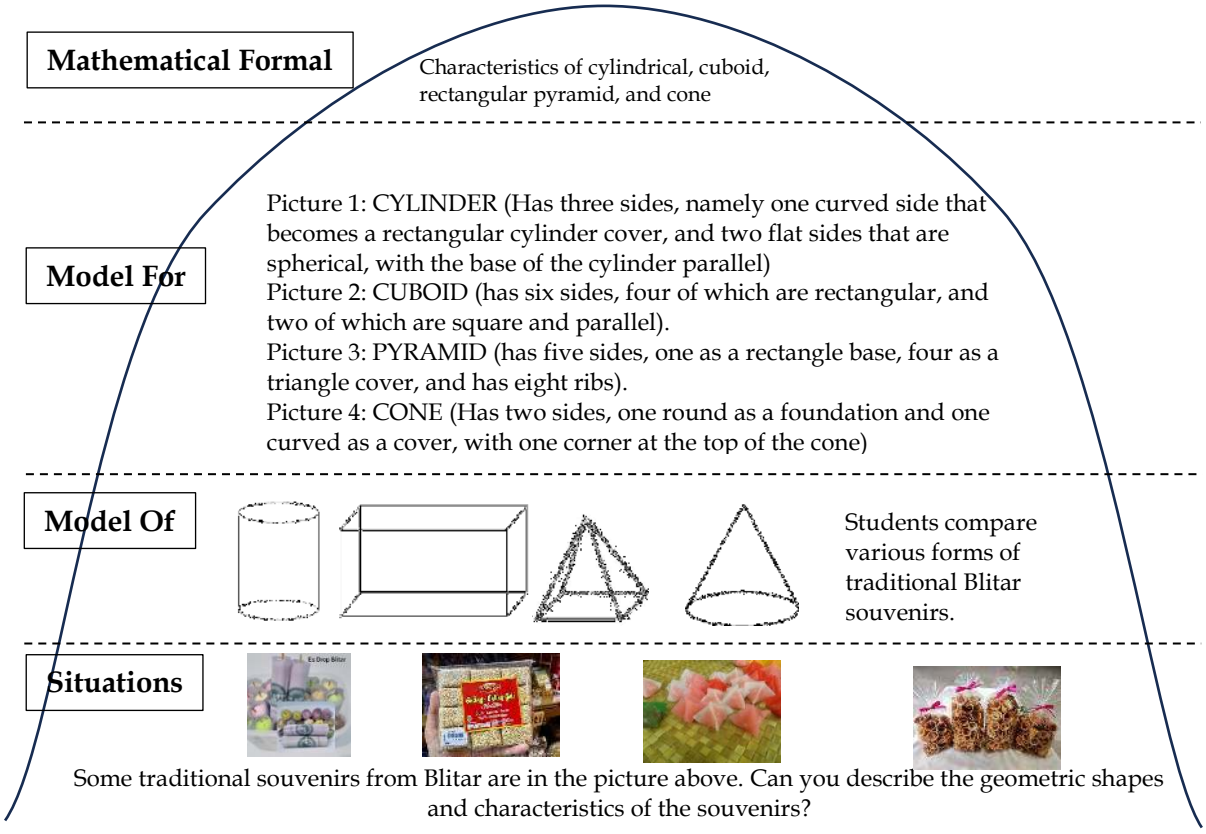

Figure 1. Illustration of *iceberg* RME

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The Hypothetical Learning Trajectory (HLT) presents the design of the activity explanation illustrated in the iceberg diagram (iceberg illustration) in Figure 1 and is detailed in depth in Table 1 below:

Table 1. *Hypothetical Learning Trajectory* (HLT)

Activity	Level	Alleged Learning Process
Students predict the three-dimensional shapes and qualities found in traditional Blitar souvenirs.	Situations	Students quickly identify the three-dimensional shapes for each of the classic Blitar souvenirs.
Students are shown examples of traditional Blitar souvenirs (es drop, geti, wajik kletik, and opak gambir).	Model of	Students focus on distinguishing between es drop, geti, wajik kletik, and opak gambir.
Students are asked whether the name of the geometric shape matches the traditional souvenirs from Blitar (es drop, geti, wajik kletik, and opak gambir).		Students can identify the three-dimensional shapes of ice droplets, geti, wajik kletik, and opak gambir.
Students are asked stimulation questions like, "How many sides and angles are there on an ice drop, geti, wajik kletik, and opak gambir?"		Students count the sides and angles of ice drops, geti, wajik kletik, and opak gambir.
Students complete geometric shape criteria to identify the three-dimensional shapes seen in typical Blitar souvenirs.	Model for	Students identify geometric properties such as side shape, number of sides, and angles.
Students answer the presented issue by describing the features of three-dimensional shapes based on the shapes of traditional Blitar souvenirs.	Formal	Students address these issues by describing the properties of relevant three-dimensional shapes.

C. Result and Discussion

Result

The researcher divided learning activities into four stages to help students understand the notion of spatial forms in a contextual and participatory manner. The first step is where students are asked to identify distinct three-dimensional shapes in Blitar souvenirs. At this stage, students are presented with real-world events involving concrete items, such as the physical form of the memento, which allows them to distinguish diverse three-dimensional shapes immediately. This practice seeks to foster initial understanding and pique students' interest in the content to be studied.

The second level is Model, which involves students describing the geometric shapes they have previously observed. At this point, students start representing their discoveries with images, which helps them combine visual notions with mathematical understanding. Furthermore, the Model for Stage requires students to describe geometric shapes utilizing

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traditional Blitar souvenirs such as geti snacks in various shapes, es drop, opak gambir, and dodol belimbing as teaching aids. This project helps students improve their critical thinking abilities by using everyday objects to explain the notion of three-dimensional shapes in greater detail. Finally, in the formal mathematics stage, students are instructed to conclude the complete series of exercises, allowing them to formulate and organize the concept of three-dimensional shapes abstractly and formally based on their concrete experiences.

Activity 1

The teacher begins the lecture by asking the students what three-dimensional shapes they are already familiar with. The teacher assesses the student's knowledge of three-dimensional shapes and their features. The following exercise begins once the teacher has collected the necessary information. Students participate in this exercise by reading about Blitar, the City of Proclamation. The reading includes images to assist kids in grasping it. The teacher begins the lecture by asking the students what three-dimensional shapes they are familiar with. This is done by the teacher in order to assess the student's knowledge of three-dimensional shapes and their features. The following exercise begins once the teacher has gathered the necessary information. Students participate in this activity by reading a passage on Blitar, the City of Proclamation. Pictures are included in the reading to assist students in understanding the content.

Teacher: "Students, have you ever been to Bung Karno's Grave?"
Student: "Yes, Teacher, I was on vacation visiting Bungkarno's Grave yesterday."
Teacher: "Okay, students, try reading the text about Blitar, the City of the Proclaimer, first!"

As part of their introductory knowledge, students are asked to read the reading material on Blitar, the City of Proclamation, which the teacher provides.

Figure 2. LKPD Page Reading Text the Blitar City of Proclamation.

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Following an understanding of the reading material above, the teacher connected Blitar's customary keepsakes to the student's knowledge of three-dimensional shapes. Then, the following conversation happened:

Teacher: "Do you know about three-dimensional shapes?"
Students: "Yes, ma'am."
Teacher: "What three-dimensional shapes are there?"
Students: "Cubes, cubes, cones."
Teacher: "Yes, that's right. Then come on, kids, please observe the reading in the LKPD and find out what three-dimensional shapes there are!"
Students: "Ma'am, there are several pictures of different three-dimensional shapes."
Teacher: "Come on, youngsters, try to figure out the three-dimensional shapes in these photographs.

Figure 3. Pictures that Students must Observe

In activity 1, it was discovered that students only know a few basic shapes and their features.

Activity 2

In this lesson, students are invited to investigate the three-dimensional shapes depicted in several images of Blitar souvenirs. After identifying the three-dimensional shapes, students can compare them to the LKPD. The conversation went as follows:

Teacher: "What pictures do you find that you can match with the pictures next to the photos provided!"
Students: "Ma'am, do we need a ruler for this?"
Teacher: "Yes, please. "Ma'am, may I ask which geometric shape this ice drop should be matched with?"

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Students: "The one that looks like a bottle tube, ma'am."
Teacher: "Wow, that's great, try drawing a straight line on the corresponding picture on the page!"

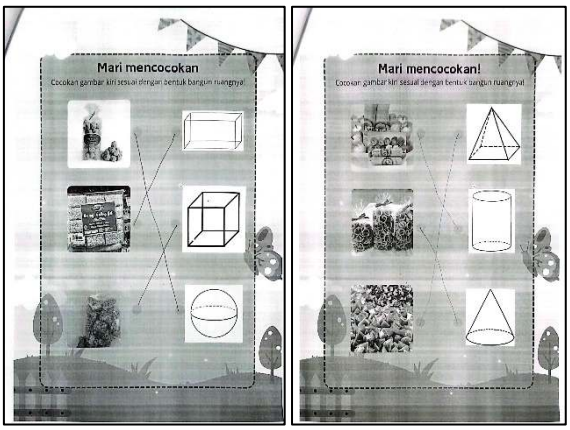

Figure 4. The Process of Matching Image Shapes

Students can match the photographs corresponding to the image's shape using the findings of the preceding study. Most of the matched photos are consistent with existing spatial arrangements. Students use rulers and pencils during the matching process. Students are passionate about matching the contour of the image.

Activity 3

The activity consists of activities designed to determine the features of previously discovered three-dimensional shapes. The teacher uses several photos to help students identify the qualities of cylindrical, pyramidal, and cone three-dimensional shapes. Meanwhile, the teacher decides to use concrete items, such as geti/enting-enting, to help students identify the features of cuboids, cubes, and circles.

Figure 5. Various Forms of Geti

The image above depicts the geti seen by students comparing the properties of three-dimensional shapes. Students are instructed to examine each side shape in each geti shape. Before examining the side shape, the teacher inquires what the geometric object's side is called. Students respond by indicating its location. The following is a conversation that occurs throughout this activity.

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Teacher: "Take a look at this cube shape, what three-dimensional shapes are formed?"
Students: "There are cuboids, cubes, and circles, ma'am."
Teacher: "Is a circle a geometric shape?"
Students: "No, ma'am, it should be a sphere."
Teacher: "Yes, it's a sphere, let's observe again what the sides of the geometric shape look like!"

Students are then asked to determine the number of sides that geti has on each shape. Previously, the teacher inquired which section of the geometric object was referred to as its side. Students can indicate where the side is on the geometric shape geti. Students can identify Yeti's side based on the teacher's observations. Students can also count the number of sides on Geti. The following is the conversation that occurred:

Teacher: "After you observe the shape of the geometric shape on this geti, try which one is called a side?"
Students: "This one, ma'am." At the same time, they demonstrate the location of the side they know.
Teacher: "That's correct. Now, try counting the number of sides on each shape!"

The next assignment requires students to count the amount of angles on the geti. Previously, the teacher first explained to the students where the corner points were. Then, students can calculate the corner points on each geti shape. As students can see, a block of 8 corner points contains many corner points. The conversation went as follows:

Teacher: "Now we will look for the corners of a geometric figure. "Where are the corner points?"
Students: "Here, ma'am." Where the ends of the lines intersect."
Teacher: "Yes, that's right, now try to find the corner points on the cuboid!"
Students: "There are 8 corner points, ma'am."
Teacher: "Yes, that's right, now let's move on to other three-dimensional shapes."

The final action in the third activity is to identify the features of three-dimensional shapes using photos from the LKPD. The teacher instructs students to observe the three-dimensional shapes and to identify the shape of the side, the number of sides, and the number of corner points in the image. The following is a conversation that occurs.

Teacher: "Now, try to find the shape of the side, the number of sides, and also the number of corner points on other three-dimensional shapes in the LKPD!"
Students: "Is this written in the LKPD, ma'am?"
Teacher: "That's correct."

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Figure 6. Students Record Their Discoveries abou the Features of Three-Dimensional Shapes

Students need help identifying the number of corner points in a spherical geometric figure at this stage. As a result, the teacher informs the students that a sphere lacks corner points and consists of curving lines with no ends. This allows students to complete the features of the geometric figures found.

Activity 4

In the last activity, the teacher asks students to determine the geometric forms' names corresponding to each of the traditional Blitar souvenirs. Students can list the qualities of geometric forms in order, according to the information they have gained during the phases of the activities they have completed.

Figure 7. The Teacher Instructs the Students to Write Conclusions

Discussion

Based on the results of learning activities, it is known that students' learning phases and activities align with the Hypothetical Learning Trajectory (HLT). This is visible in the first activity, which takes the form of tasks to determine the forms of three-dimensional shapes. In this activity, students can name the flat forms they find. The second is the Model, an activity describing what three-dimensional shapes have been discovered. According Nurhayati et al (2021) believe that having emotional intelligence influences students' critical thinking skills when solving problems. Students can find any three-dimensional shapes

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based on the arranged flat shapes if they retain concentration. The third is the Model, which takes the form of an activity and describes three-dimensional shapes using the attributes discovered. According to Suharjana (2008), Students can learn about three-dimensional shapes by examining the shapes of common objects. This project allows students to see the shapes of classic Blitar souvenirs such as cube-shaped geti, blocks, and balls. The fourth category is formal mathematics, which takes the form of reaching conclusions. Students can develop their conclusions using critical thinking abilities.

Furthermore, to help students develop knowledge, they can follow the LKPD and teacher's instructions clearly and cohesively. According to Primasari et al (2021), The RME approach comprises many stages of research activities that serve as the primary reference in all learning activities. This study is led by RME characteristics, specifically using context at the start of the activity to increase students' motivation and interest in learning.

The results of teacher observations in the classroom can also determine this. For example, before the content begins, students may only describe a few characteristics of fundamental geometric forms; nevertheless, once the material begins, students can mention the properties of the three-dimensional shapes they have learnt. They can also recognize three-dimensional shapes with multiple sides and vertices. This is also consistent with Primasari et al (2021), who discovered that using media in realistic mathematics learning (RME) can help students transition from abstract to more real-world settings.

D. Conclusion

Based on the research that has been conducted, the design of mathematics learning activities with the RME and ethnomathematics approaches using Blitar's traditional souvenir media on the characteristics of three-dimensional shapes has emerged through the HLT that has been designed, namely, starting with situation activities, which involve observing text and images, then Model of activities, which involve matching, then Model for activities, which find the characteristics of three-dimensional shapes.

This design has significant implications for mathematics learning, particularly in developing students' understanding of three-dimensional shapes and their relevance in everyday life. It aims to increase conceptual understanding through real-world contexts, integrate cultural values into mathematics learning, increase motivation and interest in learning, develop critical and creative thinking skills, and raise awareness of the application of mathematics.

Further study suggestions include the following: 1) More researchers can create variations of local products as a learning context; 2) More researchers can integrate mathematics and culture more deeply; 3) More researchers can conduct research at different levels of student ability; 4) More researchers can collaborate with cultural experts and local communities; and 5) More researchers can create digital and innovative learning materials using RME and ethnomathematics approaches.

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