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Ethnomathematics: Delving into the Art of Ketan Pencok, a Bumiayu Tradition, as a Source for Mathematics Learning

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Abstract: Mathematics education in schools often still relies on abstract concepts, making it difficult for many students to learn mathematics. Therefore, educators need to transform these abstract mathematical concepts into concrete ones by connecting mathematics with the local culture. Brebes Regency is one example of a region rich in culture. Educators can integrate this culture into mathematics learning through Ketan Pencok, a traditional snack from Bumiayu. Without realizing it, the process of making Ketan Pencok involves mathematical concepts. This study aims to explore activities involving mathematical concepts found in the process of making Ketan Pencok, a traditional snack from Bumiayu. The research is a descriptive qualitative study using an ethnographic approach. Data collection techniques used include observation, interviews, and documentation. Data analysis techniques involve data reduction, data presentation, and conclusion drawing. The study shows that the process of making Ketan Pencok involves mathematical concepts such as two-dimensional geometric shapes (rectangles and circles) and three-dimensional shapes (open cylinders, hemispheres, rectangular prisms, and cubes), division, proportionality, social arithmetic, and linear equations with two variables, which can be used by educators as a source for contextual mathematics learning.

Keywords: *devision; ethnomathematics; geometry; ketan pencok snack; social arithmetic*

A. INTRODUCTION

Mathematics is a universal science that serves as the foundation for the development of modern science and technology (Rohman et al., 2021). It is also one of the subjects taught in schools, from elementary to high

school levels, and is fundamentally intertwined with daily life activities. By learning mathematics, students can enhance their thinking skills, providing a basis for the knowledge they acquire during the learning process (Alhaq et al., 2014).



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The learning process is a set of activities and experiences provided by the teacher to the students (Simbolon et al., 2020). Therefore, mathematics learning is the approach taken by the teacher to conduct lessons so that the concepts presented can be understood by the students (Citra, 2017). The goal of mathematics learning is to develop students' potential by encouraging them to think logically and relate mathematical concepts to everyday life (Sadiyah & Suparni, 2022).

The early introduction of mathematics education should make the subject easier for students to understand. However, in reality, many students struggle with learning mathematics because it often involves abstract concepts, making it difficult to grasp (Rakhman et al., 2021) (Wahyudi, n.d.). Therefore, teachers need to transform these abstract mathematical concepts into concrete ones during the learning process (Jamawi & Akbar, n.d.). Additionally, students should be trained to apply mathematical concepts in their daily lives, such as through the cultural practices of their local communities, as the ability to understand mathematical concepts is crucial for students to possess (Simbolon et al., 2020) (Meidianti et al., 2022).

The culture of the community in our surroundings can serve as a tangible learning resource for students (Marni & Nina, 2023). The integration of mathematical concepts with local cultural practices is known as ethnomathematics. Ethnomathematics is not about any specific ethnicity or group; rather, it explores how mathematics adapts to culture (Richardo,

2016) (Mayang et al., 2021). The term "ethnomathematics" was introduced by Brazilian mathematician Ubiratan D'Ambrosio. According to D'Ambrosio, the prefix "ethno" refers to a recognizable cultural group, while the suffix "tics" refers to the art of technique. Therefore, ethnomathematics can be understood as the study of a community's culture and historical heritage in relation to mathematics learning (Huda, 2018).

The culture of the community in Brebes Regency, located at the western tip of Central Java, bordering Cirebon Regency in West Java, holds a variety of traditions, customs, and practices that are distinct from other regions. One such tradition that has been preserved and continues to be practiced from centuries ago to the present is the Ngasa Ritual. Additionally, traditions and cultural practices still maintained today include Mitoni, Gelar Tradisi Jalawastu, Prepegan, Sinoman, and Tilik. Brebes Regency is also known for its traditional foods, such as Sogol snacks, Ketan Pencok, Krupuk Rambak, and others (Rizkiana et al., 2020). Among the various cultural and unique aspects of Brebes Regency, this study aims to highlight the local culture, specifically the traditional food Ketan Pencok from Bumiayu, as a source for learning through ethnomathematics.

The inventor of Ketan Pencok was the late Mrs. Bariyah, who initially sold pecel on Protokol Street in Bumiayu. However, due to poor sales, Mrs. Bariyah decided to create something different and unique. She experimented by making ketan with a topping of serundeng, and it turned out to

be very popular. Initially, Mrs. Bariyah sold her product from one location to another. Before her passing, she passed the recipe for Ketan Pencok to her only child, Aminah. Starting from selling on the sidewalks, Mrs. Bariyah's Ketan Pencok now has two kiosks: one on Pangeran Diponegoro Street near Pasar Induk Bumiayu, and another on KH Ikhsan Turmudzi Street, Number 21, Bumiayu (Oktafiani, 2019).

From the various cultures and specialties present in Brebes Regency, there have been previous studies examining the local culinary specialty of Brebes, namely Salted Eggs. The aim of this research is to use it as a learning resource for mathematics, specifically for the material of Systems of Linear Equations in Two Variables (SLETV) (Karuna et al., 2022). However, this study has a unique interest in a traditional snack from Bumiayu called Ketan Pencok. Therefore, it is necessary to conduct research on this snack with the goal of exploring and analyzing the mathematical concepts involved in the process of making Ketan Pencok from Bumiayu. The process of making this snack includes various tools, ingredients, and stages that can be used as a mathematics learning resource. Thus, this learning resource can be utilized by educators to explain concepts to students, making it easier for students to understand mathematical concepts. Cultural values surrounding the snack can also be understood and implemented more easily by the students (S. Ahmad, 2018). Based on the discussion above, the researcher is interested in studying the preparation of Ketan Pencok from Bumiayu as a student learning resource.

B. MATERIALS AND METHODS

This type of research is descriptive qualitative research. Descriptive research is an exploration and clarification of social events or realities by describing a number of variables under study (Sadiyah & Suparni, 2022). Thus, descriptive qualitative research is a type that relies more on analysis, where the process and meaning of the research are emphasized based on theories that can be used as references, ensuring that the research focus aligns with field facts.

This research employs an ethnographic approach. Ethnography, as one type of approach in qualitative research, involves the researcher investigating culture in its natural setting through observation and interviews (Harahap & Rakhmawati, 2022). Based on the type and approach of this research, the instrument used is the human instrument, where the researcher is directly involved in the study and acts as the data collector, a role that cannot be replaced (Pathuddin & Raehana, 2019). Therefore, data collection techniques are carried out through observation, interviews, and documentation.

The data sources used are primary and secondary sources (Sadiyah & Suparni, 2022). Primary data is obtained directly through the exploration of the local food of Brebes, Bumiayu, specifically the Ketan Pencok snack and its relation to mathematical concepts. Meanwhile, secondary data is obtained from studies and journals related to the topic.

The research procedure involves exploration, documentation, and literature review. This procedure is carried out during

the identification of ethnomathematics in the local food of Brebes, Bumiayu, specifically the Ketan Pencok snack. The Ketan Pencok snack may contain mathematical concepts that can facilitate mathematics learning.

The data analysis technique in this research follows the approach of Miles and Huberman, which is a qualitative method applied to the data obtained. Qualitative data is processed through three stages: data reduction, data presentation, and conclusion drawing (Sadiyah & Suparni, 2022). This process continues throughout the research. Data reduction is performed to extract important parts related to the research (R. Ahmad, 2018). Data presentation is done to view the overall picture of the mathematical concepts found in the production process. Finally, conclusions are drawn regarding the ethnomathematics involved in the production of Ketan Pencok and its contribution to mathematics learning.

C. RESULT AND DISCUSSION

In this study, ethnomathematics is emphasized in the process from the production to the sale of Ketan Pencok, a traditional snack from Bumiayu, conducted by the Ketan Pencok makers in Kalierang Village, Bumiayu District, Brebes Regency. The description of ethnomathematics is provided through interviews with Ketan Pencok makers, which are then confirmed through direct observation of the Ketan Pencok production process and supported by documentation. The mathematical concepts derived from this research include geometric concepts such as two-dimensional

shapes (circles, rectangles) and three-dimensional solids (cubes, rectangular prisms, open cylinders, hemispheres), as well as concepts of division, social arithmetic, proportionality, and Systems of Linear Equations in Two Variables (SLETV).

1. Geometric Concepts (Two-Dimensional Shapes and Three-Dimensional Solids)

Dialog 1

Researcher : How many processes are involved in making ketan pencok?

Ketan Pencok Maker : There are two processes involved: making the ketan (glutinous rice) and making the pencok seasoning.

Researcher : What is the first step in making Ketan Pencok from Bumiayu?

Ketan Pencok Maker : Soak the glutinous rice to be prepared and take the cleaned coconut from the bucket (a cylindrical container without a lid). Then, grate the coconut using a grater, and place the grated coconut into a round basin. After that, squeeze the coconut to extract the coconut milk. The coconut milk and the coconut pulp are separated, as the squeezed coconut pulp will later be used for the pencok seasoning.

Researcher : So, the squeezed coconut pulp is not discarded?

Ketan Pencok Maker : Yes, it's not discarded because the base ingredient for the pencok seasoning is made from the squeezed coconut pulp.

Researcher : Next?

Ketan Pencok Maker : Next, boil the coconut milk in a pot (a cylindrical container without a lid) and stir it continuously to prevent it from curdling, ensuring a good result. While boiling the coconut milk, prepare the washed rice and drain it to reduce the moisture content. Then, place the rice into a pot

filled with water and start steaming it.

Researcher : What comes next?

Ketan Pencok : Then, transfer the steamed rice

Maker : into a basin and add the boiled coconut milk to the glutinous rice, mixing thoroughly. Wait until the coconut milk is absorbed into the rice. After it has absorbed, proceed with the second steaming process and wait until it is fully cooked.

Researcher : Does this process take a long time?

Ketan Pencok : Yes, it takes about 1 hour, with

Maker : two steaming processes.

Researcher : What comes next?

Ketan Pencok : The nggeblek process.

Maker :

Researcher : What kind of process is nggeblek?

Ketan Pencok : Nggeblek is the process of

Maker : pounding glutinous rice to make it denser and easier to shape. This process is usually done after the rice has cooled down.

Researcher : Are there any more processes?

Ketan Pencok : The process of making the

Maker : ketan is complete. Next, transfer the ketan to a rectangular ceramic table measuring 30 cm x 30 cm with seven ceramic tiles. Then, cut the ketan into pieces that are 5 cm long, 3 cm wide, and 1 cm thick (rectangular blocks). Usually, after cutting, the ketan is transferred to a round tray lined with cleaned banana leaves.

Dialog 1 in this study represents the process of making Ketan Pencok, a traditional snack from Bumiayu, starting from washing the glutinous rice to the preparation of the Ketan, including the process of cutting the Ketan to ensure uniform shapes. The tools used by the makers of Ketan

Pencok at the stages involving geometric concepts are presented in Table 1.

Dialog 2

Researcher : After the Ketan is finished, what comes next?

Ketan Pencok : After the Ketan is ready, the

Maker : next step is to make the pencok seasoning.

Researcher : What is the first step?

Ketan Pencok : Prepare the coconut pulp, then

Maker : roast it in a pan (a half-spherical shape) along with the chopped spices, which include shallots, garlic, ginger, and chili, using a wooden spatula.

Researcher : How long does the roasting process take?

Ketan Pencok : The roasting time is variable

Maker : and depends on the amount of coconut pulp. It is usually indicated by the pulp turning brown. After it's cooked (brown in color), wait until it cools down and then prepare palm sugar to mix with the pulp.

Researcher : What comes next?

Ketan Pencok : Next, grind the palm sugar until

Maker : it is fine. Once fine, add the roasted coconut pulp and grind again until well mixed. Once combined, the pencok seasoning is ready. After that, wrap the seasoning in small rectangular plastic bags.

Dialog 2 in this study explains the process of making the Pencok seasoning for Ketan Pencok, a traditional snack from Bumiayu, which includes roasting the coconut and packaging the seasoning. The tools used by the makers of Ketan Pencok are in the shape of rectangular prisms and rectangles. The geometric concepts involved are listed in Table 1.

Dialog 3

Researcher : After completing both of these processes, what comes next?

Ketan Pencok : Next is the packaging process.

Maker : The container used is a

bamboo woven basket (cube-shaped). Each basket is labeled with a logo sticker measuring 8 cm x 5 cm (rectangular).

Dialog 3 in this study describes the packaging process of Ketan Pencok, where the containers are in the shape of cubes and the stickers attached to the baskets are rectangular. The geometric concepts involved are listed in Table 1.

Table 1. Mathematical Concepts in the Process of Making and Packaging Ketan Pencok from Bumiayu

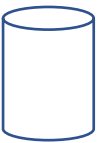
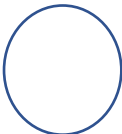
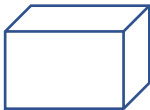
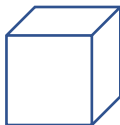
The Process from Production to Packaging	Mathematical Concept	Geometric Model
 Figure 1. Washing Coconut	Tube without cap	 Figure 2. Tube without cap
 Figure 3. Grating coconut	Circle	 Figure 4. Circle
 Figure 5. Steaming rice	Tube without cap	Figure 2.
 Figure 6. Placing sticky rice on the table	Rectangle	

Figure 6. Placing sticky rice on the table		Figure 7. Rectangle
 Figure 8. Formation of sticky rice	Beam	 Figure 9. Beam
 Figure 10. Roasting coconut dregs	Half ball	 Figure 11. Half sphere
 Figure 12. Cutting pencok spices	Beam	Figure 9.
 Figure 13. Pencok seasoning container	Rectangle	Figure 7.
 Figure 14. Pencok sticky rice container	Cube	 Figure 15. Cube
 Figure 16. Pencok sticky	Rectangle	Figure 7.

rice logo sticker		
	Circle	Figure 4.

Figure 17.
Sticky rice container

2. Division Concepts

From the shape of the Ketan Pencok in image 6, if the Ketan Pencok measures 1 ceramic tile with dimensions of 30 cm × 30 cm, then the area of the Ketan Pencok is 900 cm². Using a ruler to straighten the cuts, each piece of Ketan Pencok measures 5 cm × 3 cm = 15 cm². Therefore, each ceramic tile will produce 900 cm² ÷ 15 cm² = 60 pieces of Ketan Pencok.

3. Social Arithmetic Concepts

The preparation of Ketan Pencok requires several ingredients, namely glutinous rice as the main ingredient, with coconut and sugar as additional components. For the pencok seasoning, different types of sugar are used, including palm sugar, powdered sugar, and coconut sugar. Each preparation has different quantities and prices for the ingredients, such as 13 kg of glutinous rice, 15 coconuts, 4 kg of palm sugar, ½ kg of powdered sugar, and ½ kg of coconut sugar.

Table 2. Ingredients for Ketan Pencok

Material Name	Price per unit	Total Materials	Total price
Glutinous rice	Rp. 23.000	13 kg	Rp. 299.000
Coconut	Rp. 6.000	15 seeds	Rp. 90.000

Palm sugar	Rp. 23.000	4 kg	Rp. 92.000
Ant Sugar	Rp. 32.000	½ kg	Rp. 16.000
Palm sugar	Rp. 80.000	½ kg	Rp. 40.000
Spice	-	-	Rp. 70.000
Besek	Rp. 1.400	53	Rp. 74.200
Stickers	Rp. 1.000	53	Rp. 53.000
Plastic	Rp. 1.500	1	Rp. 1.500
Total	-	-	Rp, 735.700

From Table 2, it can be seen that the total investment used is Rp. 735,700. This investment will produce 60 pieces of Ketan Pencok, as explained in the above distribution concept. If there are a total of 7 ceramic tiles, then the total number of Ketan Pencok produced in one batch is 60 pieces × 7 tiles = 420 pieces.

If one basket contains 8 pieces of Ketan, then it can produce $\frac{420}{8} = 52.5$ baskets. Each basket is priced at Rp 20,000. If all the baskets are sold, the total revenue would be 52.5 × Rp 20.000 = Rp 1.050.000.

Thus, the profit generated from one production process is:

$$\begin{aligned}
 \text{Profit} &= \text{Total Sales} - \text{Total Capital} \\
 &= \text{Rp } 1.050.000 - \text{Rp } 737.700 \\
 &= \text{Rp } 314.300 \\
 \text{Profit Percentage} &= \frac{\text{Amount of Profit}}{\text{Purchase Price}} \times 100\% \\
 &= \frac{\text{Rp. } 314.300}{\text{Rp. } 20.000} \times 100\% \\
 &= 5.715\%
 \end{aligned}$$

Therefore, it can be concluded that the profit percentage for each production is 15.7%.

4. Comparison Concept

From the size of the ceramic table used for the Ketan Pencok in Image 6, which measures 30 cm x 30 cm per tile, each tile produces 60 pieces of Ketan. If there are 7 tiles, the total production is 420 pieces of Ketan. If the Ketan Pencok maker can produce twice a day, then the total daily production is $\frac{1}{\text{day}} = \frac{2}{\text{day}} \Leftrightarrow x = 840$ pieces of Ketan pencok.

5. Systems of Linear Equations in Two Variables (SLETV) Concepts

Ketan Pencok can be related to mathematics education, specifically of linear equations with two variables. The linear equation problem is presented using a story-based method, such as the following example:

"Ajil buys 1 basket containing 8 pieces of Ketan Pencok for Rp. 20,000. If the basket itself costs Rp. 2,400, what is the price of one piece of Ketan Pencok?"

This story problem can be solved using a mathematical approach as follows:

Given:

x = Ketan Pencok

y = basket

y = Rp. 2.400

Question: What is the price of one piece of Ketan Pencok?

The mathematical model obtained is as follows: $8x + y = \text{Rp } 20.000$

Solution:

$$8x + y = \text{Rp } 20.000$$

$$8x + \text{Rp } 2.400 = \text{Rp } 20.000$$

$$8x = \text{Rp } 20.000 - \text{Rp } 2.400$$

$$8x = \text{Rp } 17.600$$

$$x = \frac{\text{Rp. } 17.600}{8}$$

$$x = \text{Rp } 2.200$$

Therefore, the price of one piece of Ketan Pencok is Rp 2.200

6. Ketan Pencok from Bumiayu as a Contextual Problem in Mathematics Learning

The process of making Ketan Pencok, a traditional snack from Bumiayu in Brebes Regency, can be used as a contextual problem to be developed by students in mathematics learning. This contextual problem provides students with the opportunity to solve real-world issues, leading to a more comprehensive understanding. The mathematical concepts involved in the production and sale of Ketan Pencok can be explained by educators. An example of culturally-based learning, especially in the context of making traditional snacks such as Ketan Pencok from Bumiayu, Brebes Regency, that can be used in mathematics education is as follows.

7. Geometric Concepts

Based on the research findings, it is evident that in the initial stage of production, the coconut washing process can use a bucket, which is in the shape of an open cylinder. Educators can explain the subsequent steps of making Ketan Pencok, such as grating the coconut and placing the grated coconut into a basin with a circular top. Next, the spiced coconut residue is roasted using a pan shaped like a hemisphere. In the following process, the cooked Ketan is placed on a rectangular table. The Ketan is then cut into equal pieces, resulting in

rectangular prisms. The final step is wrapping the Ketan Pencok in baskets shaped like cubes. Educators can pose the following questions to the students:

- a. Ms Mubariroh is a maker of Ketan Pencok, a traditional snack from Bumiayu. For each batch, Ms Mubariroh can produce Ketan using a mold with dimensions of $420\text{ cm} \times 120\text{ cm} \times 2\text{ cm}$. Based on these dimensions, determine the volume of the mold used!
- b. Ms Mubariroh will make Pencok seasoning from coconut residue. During the roasting process, she uses a pan shaped like a hemisphere with a diameter of 70 cm. If the pan is filled to capacity with coconut residue, what is the volume of the pan used by Ms Mubariroh for roasting?

8. Division Concepts

Based on the research findings, during the process of placing the Ketan on a rectangular table, the Ketan is cut into pieces of the same size, resulting in a consistent number of pieces. Educators can ask the following questions to the students:

- a. It is known that Ms Mubariroh has 420 pieces of Ketan ready to be placed into baskets. If each basket contains 8 pieces of Ketan, how many baskets are needed to hold all the available pieces of Ketan?

- b. It is known that Ms Mubariroh molds Ketan Pencok with the dimensions of $30\text{ cm} \times 30\text{ cm} \times 2\text{ cm}$ using a mold. How many pieces of Ketan does Ms Mubariroh produce from one mold if each piece of Ketan measures $3\text{ cm} \times 5\text{ cm} \times 2\text{ cm}$?

9. Social Arithmetic Concepts

Educators can explain that profit is obtained if the total sales exceed the total capital invested. Educators can ask the following questions to the students:

- a. Ms Mubariroh will make Ketan Pencok, a traditional snack from Bumiayu, with a total capital investment of Rp 450,000 for one production process. If 40 baskets of Ketan are produced and each basket is sold for Rp 20,000, what is the percentage of profit earned by Ms Mubariroh from one sale?
- b. Intan intends to buy 15 baskets of Ketan Pencok, a traditional snack from Bumiayu, with each basket priced at Rp 18,000. Since Intan is buying a large quantity, she is given a 10% discount. How much does Intan have to pay after receiving the discount?

10. Proportionality Concepts

Educators can explain that the more glutinous rice used to make Ketan,

the greater the amount of Ketan produced, and vice versa. Educators can ask the following questions to the students:

- a. If one roasting of coconut residue in a hemisphere-shaped pan with a diameter of 70 cm takes 1.5 hours, how long will it take in total to roast the coconut residue with 8 roasts?
- b. If Ms Mubariroh cuts Ketan from one mold to produce 60 pieces of Ketan, how many total pieces of Ketan will Ms Mubariroh produce if there are 5 molds of uncut Ketan?

11. Systems of Linear Equations in Two Variables (SLETV) Concepts

Based on the research findings, the price of one piece of Ketan Pencok can be determined using the concept of Systems of Linear Equations in Two Variables (SLETV). Educators can ask the following questions to the students:

- a. Ms Mubariroh plans to make Ketan Pencok, a traditional snack from Bumiayu. The ingredients needed are 13 kg of rice and 6 kg of coconut. If the price of 1 kg of rice is Rp 24,000, what is the price of 1 kg of coconut?
- b. Ms Mubariroh plans to sell Ketan Pencok, a traditional snack from Bumiayu, in containers called "besek." If the price for one container is Rp

25,000, and it contains 8 pieces of Ketan, with each piece priced at Rp 2,800, what is the price of one empty container without the Ketan?

This research indicates that there are mathematical concepts involved in the process of making Ketan Pencok, a traditional snack from Bumiayu. This aligns with the goal of ethnomathematics, which is to use culture as a teaching method to help students better understand mathematical concepts (Sadiyah & Suparni, 2022). The presence of ethnomathematics connects students with local culture, making mathematics easier to understand. Meaningful mathematics learning requires educational resources that are close to the students (Hasanah et al., 2021).

This research is consistent with studies (Pathuddin & Raehana, 2019) that have identified geometric concepts such as rectangles and circles, as well as solid geometry concepts like cylinders and spheres in traditional Bugis foods as sources for mathematics learning. Meanwhile, the concept of cubic solids has been found in ethnomathematics research related to Javanese culture as an innovation in mathematics education (Rudyanto, 2019). The concepts of rectangular solids, division, and proportional comparison were discovered in the production of tofu from Kalisari, Banyumas, which is used as a mathematics learning resource (Kumala, 2022). The concept of Linear

Equations in Two Variables was identified in research on Tegal specialties, such as Tahu Aci, used in school mathematics education (Sadiyah & Suparni, 2022). Additionally, the concept of social arithmetic was found in traditional snacks from Kemiren Village as a basis for mathematics learning (Hasanah et al., 2021). Furthermore, traditional Batak cakes containing mathematical concepts include lepet shaped like a square pyramid, kue gadong shaped like a sphere, cimpa unung-unung shaped like a triangular pyramid, and cimpa tuang shaped like a cylinder (Simanjuntak & Sihombing, 2020). Traditional snacks from Osing Tribe in Kemiren Village, Banyuwangi, have also been explored Hasanah to aid in mathematics learning. This research complements previous studies on ethnomathematics related to regional specialties. This study explores ethnomathematics with a different object than previous research, focusing on the exploration of Ketan Pencok from Bumiayu, Brebes, as a mathematics learning resource (Hasanah et al., 2021).

D. CONCLUSION

Based on the research findings, it can be concluded that delving the Ketan Pencok snack from Bumiayu, a local specialty of Brebes Regency, reveals the involvement of mathematical concepts in its production. These concepts include two-dimensional geometric shapes (rectangles and circles) and three-dimensional solids (open

cylinders, hemispheres, rectangular prisms, and cubes), as well as concepts of division, proportionality, social arithmetic, and systems of linear equations in two variables. Educators can use the Ketan Pencok snack from Bumiayu as a concrete mathematics learning resource, making the mathematics learning process more beneficial for students by involving learning resources present in their everyday life, namely their cultural background.

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