EXPLORING ETHNOMATHEMATICS IN THE TRADITIONAL GAME NAMED *ENGKLEK*

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Abstract: This study examines some mathematical objects can be learned from the traditional *engklek* game activities in *Kampung Dolanan Sidowayah*. Specifically, the purpose of this study is to find out the mathematical elements that exist in the traditional game *engklek*. Using a descriptive approach, the subjects of this study were *Budayawan*, *Kampung Dolanan Sidowayah* Manager, and children around *Kampung Dolanan Sidowayah*. Data was studied using techniques following the Spradley model include domain analysis, taxonomic analysis, componential analysis, and cultural theme analysis. The results showed that the traditional game *engklek* contains mathematical elements, namely flat planes, semicircular elements, cube webs, congruence, geometric transformations, angles, relationships between lines, line segments, flat plane area, sets, odds, permutations, numerations, distances, and implications. Having this traditional game, students might develop perspective of mathematics in their culture.

Keywords: Engklek, ethnomathematics, mathematical elements

INTRODUCTION

In the education coverage, mathematics has an important role and also has a role in it. In line with Siagian, who revealed that mathematics is a branch of science and technology, both as a tool in the application of other fields of science and in the development of mathematics itself (Siagian, 2016). A common problem that arises related this branch of science is the emergence of stigma in society that assumes that the branch of mathematics contains only formulas that are difficult to memorize and understand when taught by the teacher. Mathematics in the learning process seems to be seen as difficult, scary, or even unpleasant (Saputro, Afghohani, & Farahsanti, 2019).

New innovations are needed in mathematics learning in order to break the stigma that has arisen, one of which is using a cultural approach, better known as ethnomathematics.

Ethnomathematics is one of the interactions linking culture with mathematics. In line with Wahyudin (2018), which affirms that ethnomathematics is a legitimate descendant of interaction between culture and mathematics. Culture-based learning will later make students more familiar with culture, especially the culture they have, and can create a new atmosphere when the learning process takes place. This is in line with Wahyuni in Astutiningtyas, Wulandari, & Farahsanti (2017) that the application of ethnomathematical learning approaches is expected to help students better understand their mathematical and cultural concepts, thus indirectly instilling cultural values in them. One of the innovations that can be applied to mathematics learning is linking mathematics with daily activities that students often encounter to make it more fun. One of them can relate to play activities when the learning process takes place.

Ethnomathematics provides a broader perspective on mathematics by encompassing ideas, concepts, procedures, and practices rooted in various cultural environments. This approach increases understanding of the cognitive processes, learning abilities, and attitudes that influence classroom learning. In addition, by considering the social and political dimensions of ethnomathematics, this approach also allows the development of innovative methods for dynamic and globally localized societies (*glocalization*), which refers to increasingly intensive interaction and integration between different cultural groups (Rosa *et al*., 2016).

One of the activities that can be done in mathematics learning is to play traditional games. There are many variations of traditional games in Indonesia, one of them is the traditional game named *engklek*. The *crank* game is one of the games that contains elements of mathematics learning, this game involves jumping on a flat field in the shape of a box with jumping rules using one leg.

According to Sahertian in Kholifatuzzuhro, Sunardi, & Monalisa (2020) exploration has a meaning, namely an activity carried out in the context of learning and referring to a study with the aim of gaining more knowledge about a state or an object by collecting data to produce a new form of parable. In other words, exploration is an activity to study, analyze, and examine something deeper to find out more about a problem.

A culture cannot be separated from the pattern of community activity. Culture is abstract, complex, and vast because it is an idea contained in the human mind in everyday life. According to Melville J. Herskovits and Bronislaw Malinowski, culture is everything that exists in society determined by the culture of the society itself (Karolina & Randy,

2021). E. B. Tylor in Kholifatuzzuhro *et al*. (2020) defines culture as a complex whole in which knowledge, beliefs, arts, morals, laws, customs, and other abilities are acquired a person during their time as a member of society. Culture is an environment formed by the norms and values maintained by the supporting community. The values and norms that guide life then develop according to the various needs of society, so that they are formed into social system.

Mathematics is one of the subjects studied from elementary school to college. According to experts, mathematics is a science that studies patterns, regularities, and levels (Trisnani, 2022). According to Russeffendi ET in Rahmah (2018), The word mathematics comes from the Latin word *mathematika*, which was originally taken from the Greek word *mathematike* which means to learn. The word has the origin of the word *mathema*, which means knowledge or science (knowledge*, science*). The word *mathematike* is also related to other words that are almost the same, namely *mathein* or *mathenein* which means to learn (think). So, based on the origin of the word, the word mathematics means knowledge obtained by thinking (reasoning). Mathematics emphasizes activities in the world of ratios (reasoning), rather than emphasizing the results of experiments or mathematical observations formed by human thoughts, which are related to ideals, processes, and reasoning. It can be interpreted that mathematics is a science that is arranged in an orderly, logical, and tiered manner from the simplest to the most complicated and is the science that underlies human life regarding logic and errors related to numbers.

Rachmawati argues, as quoted by Kurniasari, Halini, & Bistari (2020) that ethnomathematics is one of the special methods used by the community in mathematical activities that include grouping, numering, measuring, counting, designing buildings or tools, determining locations, making patterns, playing games and so on. Quoted from Nur, Sukestiyarno, & Junaedi (2019) D'Ambrosio stated that the term ethnomathematics comes from the word *ethnomathematics*, formed from the words *ethno*, *mathema*, and *tics*. The prefix *ethno* refers to a recognizable cultural group, such as a tribe, in a country and professional classes in society, as well as their language and daily abilities. Then *mathema* here means explaining, understanding, and managing real things specifically by calculating, measuring, clarifying, sequencing, and modeling a pattern that appears in an environment. The suffix *tics* implies art in engineering. This means that ethnomathematics does not only talk about mathematics but also offers cultural values in its studies, in other words ethnomathematics is a form of mathematics that is influenced by or based on culture (Astutiningtyas, 2017). Ethnomathematics is one way for the

community to involve local cultural activities in learning and understanding mathematical concepts.

Subagiyo defines traditional games Safitri (2021) as games that develop and are played by children in the general public by absorbing all the wealth and wisdom of their environment. In their book, Ardini & Lestariningrum explained that traditional play and games are a legacy for generations as a very important learning tool. Traditional play and games are not intentional elements because they are related to cultural elements and aim for recreational pleasure (Ardini & Lestariningrum, 2018). Traditional games are games of cultural heritage from ancestors that must be preserved and maintained as national assets because they contain many life values and national cultural values.

The traditional game named *engklek* (in Javanese) is played by jumping on a pattern of flat, square-shaped fields that have been drawn on asphalt or soil, with the rule of jumping using one foot from one box to the next. *Engklek* can be played by at least two players but is not limited to the number of players. Each player must have a *gacuk* made of broken tiles or ceramics.

Mulyani in Ernawati (2021) which explains how to play *engklek* as follows: (1) First, draw the *engklek* field; (2) To determine the order in play by performing *hompimpa;*(3) Every player who wants to play must have a *gacuk* made of broken tiles or flat stones; (4) Players must jump with one foot on each plot field; (5) If *Gacuk* is thrown on one of the tiles drawn, then the tile containing the *gacuk* must not be stepped on by the player; (6) When throwing a *gacuk*, the player's *gacuk* must not exceed the plot field. If it exceeds it, then the player is considered void and continued by the next player; (7) The player who completes a round of *engklek* play then takes the *gacuk* with his back to the mountain, eyes closed, and must not touch the line; (8) After the player successfully picks up the *gacuk* on the mountain, then the player can get out of the *engklek* playing field by jumping up and down using one foot; (9) Then, for players to get houses or rice fields, layers must pass obstacles by placing *gacuk* on their hands and then jumping with one foot from one plot to another; (10) If you have finished passing it, then the player can throw the *gacuk* on the plot with his back to the tile, if it works then the player gets a house or rice field. The player who has the most rice fields will be the winner.

METHOD

This research uses qualitative research with an ethnographic approach. According to Le Clompte and Schensul quoted from Samsu (2017), Ethnography is a useful research method to find knowledge contained in a culture. Researchers using an ethnographic

approach will later study patterns of habits, language, and activities in a culture in natural conditions over a certain period of time through observation, interviews, and documentation.

The data collection methods used in this research are observation, interviews, and documentation. The research subjects took culturalists, *Kampung Dolanan Sidowayah* Managers, and children around in *Kampung Dolanan Sidowayah*.

The data analysis technique used refers to the Spradley analysis model. Spradley's analysis includes domain analysis, taxonomic analysis, componential analysis, and cultural theme analysis (Reksiana, 2021). Domain analysis, according to Spradley, quoted from Wijaya (2018) includes investigating larger cultural knowledge units and looking for cultural symbols included in the Domains names are based on some similarities. At the taxonomic analysis stage, researchers try to understand certain domains according to the focus of the research problem. At the componential analysis stage, researchers try to categorize elements that have been sorted with relevance. The last stage is the level of cultural theme analysis, which seeks to obtain values, cultural symbols, and cultural themes found in each domain.

RESULTS AND DISCUSSION

Based on the results of interviews, observations, and document, Researchers found a mathematical element to the traditional game named *engklek* by analyzing Spradley's model data. The stages of data analysis are described as follows:

Domain Analysis

Based on the results of the study, the researchers found two domains in the traditional game named *engklek*:

1. The activity of creating a game field design
2. Play activities

Taxonomic Analysis

Based on the domain that has been determined by the researcher in the previous stage, the researcher determines the taxonomic analysis in accordance with the activity of designing the shape of the playing field and play activities, namely:

a. In the activity of making a design of the shape of the game field, the results of taxonomic analysis were found are in the tools needed to play the traditional game of crank and the field of *engklek* game itself.

b. In playing activities, steps must be taken in playing the traditional game *of engklek*. Taxonomic analysis found in the play domain, namely:

1) Found techniques or ways to play the traditional game *of engklek.*

2) Found rules in the traditional game *of engklek.*

Componential Analysis

At this stage, researchers look for more detailed data from traditional *engklek* games to find ethnomathematics in the form of mathematical elements. Researchers determine the components that correspond to the taxonomy of activities to design the shape of the game field and play activities, namely:

The activity of creating a game field design

The results of the componential analysis found are the shape on of the tools needed in the traditional game of *engklek* and the shape on of the field of traditional *engklek.*

Play activities

The results of the componential analysis are:

a) There are techniques and ways to play the traditional game of *engklek*, namely by paying attention to the position of the hands and feet.

b) There are rules of play in playing the traditional game *engklek*, namely paying attention to the position of the feet and the position of the *gacuk.*

Cultural Theme Analysis

At this stage of analysis, an overview of ethnomathematical findings in the form of mathematical elements found will be presented:

Analysis of cultural themes in the activity of making game forms in the domain of making game form designs

Researchers determine two components, namely the tools used in playing traditional *engklek* games and the shape of the playing field. In these two components, ethnomathematics is found, which can be explained as follows:
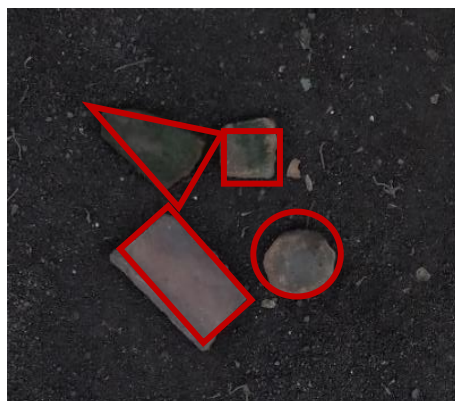
(1) Tools used in play (*Gacuk*)

Figure 1. *Gacuk* **containing flat plane elements**

Based on Figure 1, you can see various shapes of *gacuk* that contain elements of flat fields, namely squares, rectangles, triangles, and circles. In mathematics learning, the various shapes of the *gacuk* can provide children with insight into various plane shapes and their properties.

(2) *Engklek* playing field

Figure 2. An *engklek* playing field that contains elements of a flat plane

The shape of the field in the type of *engklek* game in Figure 2 contains elements of flat fields, namely squares, rectangles, and semicircles.
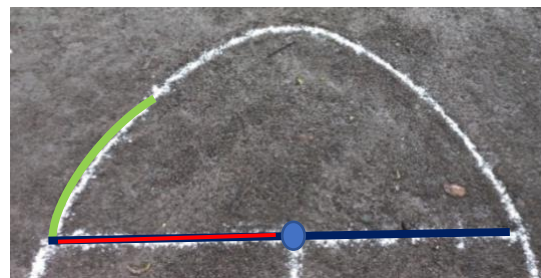

Figure 3. An *engklek gunung* playing field that contains semicircular elements

Information:

- ● : Center Point
- ── : Diameter
- ── : Jari-jari
- ⌒ : Bow

Based on Figure 3, it can be seen that the shape of the *engklek gunung* playing field contains elements in a semicircle, including the center point, diameter, radius, and arc.
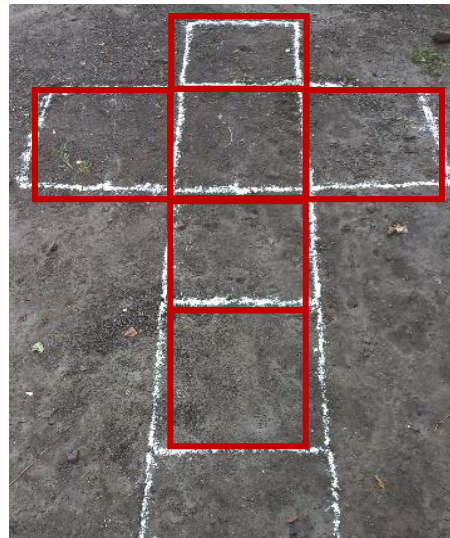
Figure 4. The *engklek kapal terbang* **field of contains elements of cube webs**

It can be seen in Figure 4 that the traditional game field of *engklek kapal terbang* contains elements of cube webs. The cube net consists of six squares which when combined will form a cube.
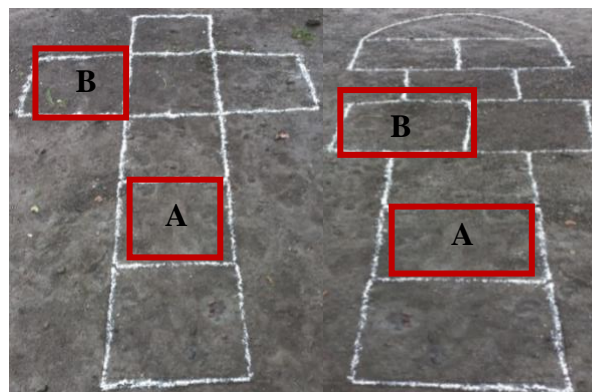

Figure 5. The *engklek* **playing field contains elements of congruence**

Based on Figure 5, mathematical elements are found in the form of congruent elements. Seen on flat plane A which has the same shape and size on flat plane B.
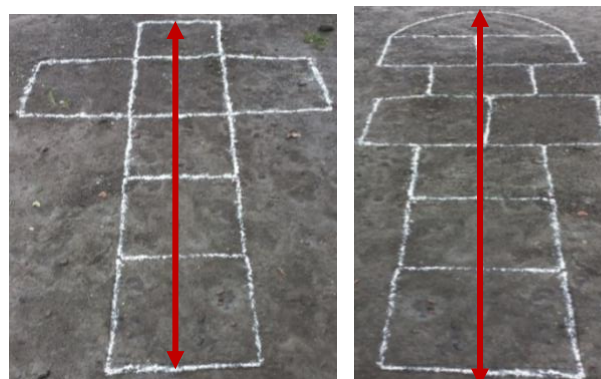

Figure 6. The *engklek* **playing field contains elements of reflection**

Based on Figure 6, the *engklek* field contains elements of reflection on the y-axis. It looks like it is mirrored when a straight line is drawn that bisects the same playing field. Where the left side has the same shape and size as the side on the right.
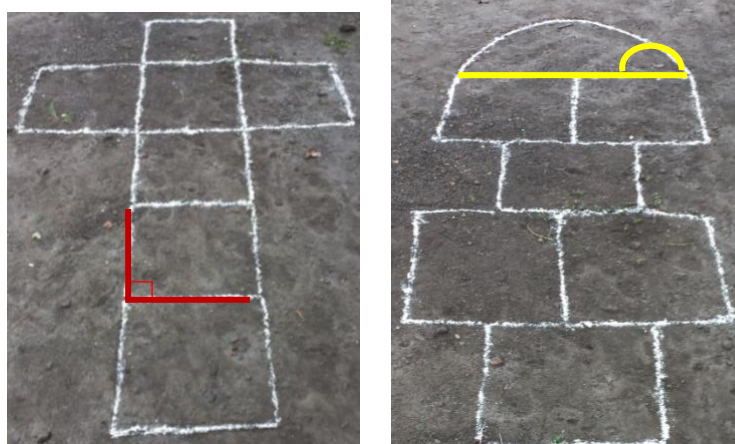

Figure 7. The *engklek* **playing field contains angular elements**

Information:

▬▬ (red)	:	Right Angle
▬▬ (yellow)	:	Straight Angle

Based on Figure 7, the shape of the *engklek* playing field contains angular elements, namely right angles and straight angles.
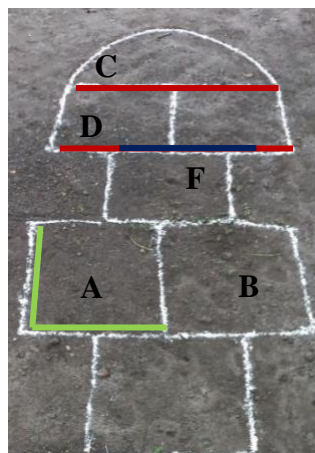

Figure 8. The *engklek* **playing field contains elements of relationships between lines**

Information:

▬▬ (red)	:	Parallel Lines
▬▬ (green)	:	Perpendicular Intersecting Lines
▬▬ (purple)	:	Lines Squeezed Together

Based on Figure 8, the shape of the *engklek* playing field contains mathematical elements of relationships between lines, namely lines that are parallel to each other, lines that intersect each other, and lines that squeeze together.
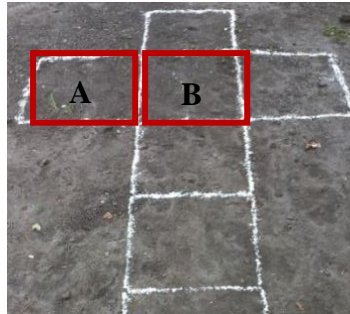

Figure 9. **The *engklek* playing field contains translational elements**

Based on Figure 9, the shape of the *engklek* field contains mathematical elements in it, namely translation or shifting.
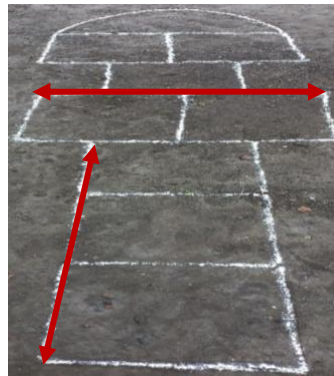

Figure 10. **The *engklek* playing field contains elements of line segments**

Based on Figure 10, the *engklek* playing field contains mathematical elements in it, namely line segment elements. Line segments are part of a line bounded by two points at the end and base.
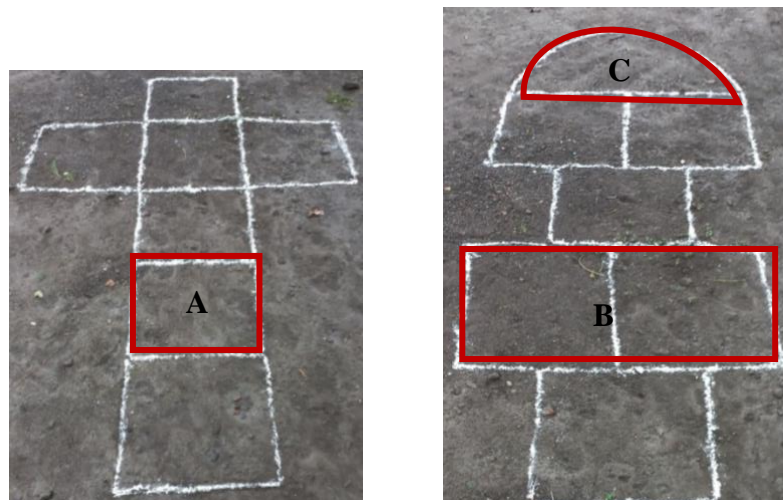

Figure 11. **Field game *engklek* load elements broad field flat**

Based on Figure 11, the shape of the *engklek* plane contains mathematical elements, namely the area of the flat plane. It can be seen in flat plane A which contains the area of a square, flat plane B which contains the area of a rectangle, and flat plane C which contains the area of a semicircle.

Analysis of cultural themes in play activities

(a) How to play

- *Pingsut* or *hompimpa*

Figure 12. *Hompimpa* **contains elements of chance, permutations, and sets**

Based on Figure 12, it was found that when the player performs *hompimpa*, there is an element of chance, it can be known the chance of the player becoming the first, second, and so on. Permutation elements to know how many sequence patterns to play can be determined by the permutation formula. There is also an element of set that is seen when each player shows one part of the palm or the back of the hand. The set elements found are the set of players showing the palm of the hand and the set of players showing the back of the hand.

- Direction of *the gacuk* move

  The *gacuk* direction contains mathematical elements of sequence and numeration. This can be seen when the *gacuk* is thrown on each box sequentially, starting from the first box onwards.

- *Gacuk* throwing

Figure 13. *Gacuk* **throwing contains an element of distance**

Based on Figure 13, when the player throws a *gacuk* and *the gacuk* falls on a certain box, it contains a mathematical element in it, namely distance.

- Search for fiefdoms

  When the player has completed a round of the game, the player has the right to choose one free box as his territory. To gain territory, the player must throw the *gacuk* with his back to the field of play. In this case, it contains mathematical elements, namely chance.

- Determining the winner

  The winner in this game is the player who has the most territory. In calculating the number of power areas owned, each player contains a mathematical element in it, namely numeration.

(b) Rules of play

- Using one foot to stand

Figure 14. **The position of the foot contains angular elements**

In the game of *engklek,* when the position of the foot is used to crank, it contains mathematical elements, namely angles. It can be seen in Figure 14, that the position of the foot when the player uses one foot forms a right angle.

- *Gacuk* and foot should not touch the line on the field of play

  When playing *engklek*, the *gacuk* and feet should not touch the lines on the plane. If it violates the rules, then the player dies and must stop to playing until waiting for the next turn. It contains mathematical elements, namely implications.

- Rules of the engklek game

  Players start by hompimpa to determine who plays first. The first player throws the gaco into the target box, and if the throw misses, he is declared disqualified. Players must jump across all the boxes with one foot, then return to pick up the *gacuk*. This process is repeated until all the boxes have been occupied by *gacuk*. The turn passes to another player if the *gacuk* does not hit the target or if a player places both feet on one box. After throwing the *gacuk* to the last box, the player can determine the safe box as "home", where he can put both feet. The winner is determined by the number of safe boxes owned.

Based on the exposure and results of research through interviews, observations, and documentation that have been carried out, it shows that the ethnomathematics of the traditional *engklek* game contains a variety of mathematical elements. The elements contained include flat planes, elements in semicircles, cube webs, congruence, geometric transformations (reflection and translation), angles, relationships between lines, line segments, flat plane area, sets, odds, permutations, numerations, distances, and implications. Some of the mathematical elements obtained can be grouped according to the material at the school level, so that they can be used as a learning medium or learning resource in mathematics learning. In line with the results of research conducted by Octaviani, Senjaya, & Taufan (2021), which explained that the traditional game *engklek* contains mathematical elements, namely elements of geometry, especially geometry in flat planes and building space, elements of algebra, translation, sets, and opportunities. The results of the same research were also put forward by Uskono, Maifa, & Bete (2021), who said that in the traditional game *sikidoka*, mathematical elements were found including the concept of straight lines, the concept of flat builds, the concept of chance, the concept of mathematical logic, the concept of numeration, and the concept of reflection or mirroring.

CONCLUSION

It can be concluded that traditional games contain mathematical elements including flat planes, cube webs, congruence, geometric transformations, angles, relationships between lines, line segments, sets, odds, permutations, numbers, distances, and the concept of mathematical logic, namely implication. The implications of this research are the traditional *engklek* games can be used as a media or learning resource in fun mathematics learning and can also be used as teacher's apperceptions in learning, whether delivered before learning, in the middle of learning, or at the end of learning. The research that has been done only the point of finding the concept of mathematical elements in general without paying attention to mathematical material according to school level, so for further research needs, those who are interested in researching culture, one of which is the traditional game *engklek*, can group several materials in according to school level and discuss them in more depth.

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