

From Traditional Game to Mathematical Representation: An Ethnomodelling Study of Congklak

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Abstract

This research examines congklak game as a local practice involving mathematics and represents mathematical aspects of the congklak using ethnomodeling approach. Using qualitative methods with an interpretive ethnographic design, data were gathered through observations of congklak players, documentation of congklak paraphernalia, and analysis of seed arrangement on the congklak board. The analysis followed emic, etic, and dialogic stages to translate local gameplay practices into formal mathematical representations. Results showed that congklak includes mathematical aspects such as enumeration, discrete distribution, one-to-one relationship, cycles, positionality, conservation of quantity, and transformations from one board position to another. Congklak mathematical structures were then represented mathematically in the form of cyclic discrete position systems, distribution function that leads to final board position, and transformations of game positions. Findings show that congklak cannot simply be described as a form of play or learning situation that takes place in a cultural context; it is also a local body of knowledge having mathematics in its operations. Ethnomodeling is further advanced as an analytical approach in lieu of descriptive ethnomathematics while acknowledging local culture as the basis of contextualized mathematics education.

Keywords: Ethnomodelling, Congklak, Traditional Games, Mathematics Education, Local Culture, Mathematical Representation

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INTRODUCTION

Traditional games represent cultural practices, which carry thoughts and operations, and reasoning principles subject to scholarly analysis (Malegiannaki & Daradoumis, 2017; Martínez-Santos et al., 2020). Within mathematics education, traditional games are not only seen as fun activities or learning materials but rather knowledge systems that reflect the practices inherent in mathematics as conducted within local culture (Fouze & Amit, 2017; Fernández-Oliveras et al., 2021; Novikasari et al., 2024). Congklak represents an example of the game whose practices incorporate aspects of local mathematics. Playing congklak involves counting and distributing seeds, defining the order of movements, estimating positions after each player's turn, and making choices regarding specific trajectories to follow. Therefore, it makes sense to analyze congklak as a mathematical practice based on the culture of its origin rather than just a play activity.

However, most studies conducted on the theme of traditional games in mathematics education have been primarily descriptive and have pointed out the presence of mathematical notions such as numbers, patterns, or arithmetic operations while not developing further and creating a mathematical framework (Fouze & Amit, 2017; Mousoulides & Sriraman, 2020). Such research leaves local cultural practices as examples illustrating knowledge rather than modelable objects. In this regard, ethnomodeling appears to be a better methodology, since it implies a higher level of integration of mathematical models within a culture than just an introduction of knowledge (Rosa & Orey, 2019; Rosa & Orey, 2021). According to Rosa & Orey (2019, 2021), ethnomodeling studies mathematically modeled phenomena using cultural elements in the modeling processes. It helps local mathematical practices become more structured in their explanations, descriptions, and representations without losing cultural meaning. As such, congklak deserves to be investigated not just as an object of ethnomathematical analysis but also as an object of ethnomodeling.

Based on the above arguments, congklak is analyzed in the present research as a cultural practice incorporating mathematical structures, which can be transformed into a mathematical model. Unlike other analyses conducted on congklak, the goal of the current investigation lies not only in identifying mathematical elements but also in revealing ways in which its seed distribution system, movement patterns, positional relations, and overall rules can be represented in a mathematical form. The objective of this research includes the investigation of congklak as a practice, the creation of a mathematical representation using ethnomodeling approach, and analysis of its implications for culture-based mathematics teaching.

The subject matter of ethnomathematics is conceived as a domain of knowledge which is far from being homogeneous and universal (Jurdak, 2016; Rosa et al., 2016; Machaba & Dhlamini, 2021). In fact, according to this view, mathematics should be understood as neither monolith nor culture free nor restricted strictly to formal education. As a result, the practices of counting, measuring, ordering, arranging, patterning and problem solving that appear among the people are viewed as valid examples of mathematical knowledge. As such, the importance of this position lies in the fact that, in contrast to the dominant perception of mathematics as merely symbols, formulae, and academic methods, it is seen as an outcome of the human activity born by the particular life conditions, habits and culture of people.

Nonetheless, ethnomathematics tends to stop at the point where mathematics is detected in some cultural practice (Amit & Abu Qouder, 2017; D'Ambrosio & Rosa, 2017; Batiibwe, 2025). In turn, this means that there is needed an approach which would be able not only to prove the existence of mathematics in certain cultural activities but also demonstrate how they could be modeled mathematically. This is the moment when ethnomodeling is relevant. Rosa & Orey (2019, 2021) maintain that ethnomodeling stands for a link between ethnomathematics and mathematical modeling, which is considered as an approach to studying mathematical phenomena by including a cultural element into the modeling process. At this point, local mathematical practices are perceived not as folklore examples, but rather as knowledge systems that can be explained by models produced in cooperation between the local and academic points of view.

Theoretically, the process of ethnomodeling implies three main approaches: emic, etic, and dialogic or glocal. While the former describes the practices according to the perception of the local community itself, the latter uses the academic terms to interpret them. Dialogic approach attempts to create a link between the two through the process of translation. Rosa & Orey (2019, 2021) point out that the purpose of constructing ethnomodels is to describe, explain, understand and represent practices of local mathematics development. Thus, the focus of research goes beyond detecting "which mathematical concepts exist" and shifts towards revealing "how the structures of local practices operate" and "how these structures can be articulated in formal mathematical representations."

Games, in particular traditional games, are examples of cultural practices with significant possibilities of investigation using ethnomodeling due to the inclusion of rules, sequences of actions, distribution, decision-making process, and strategy structures within them (Luchoro-Parrilla et al., 2021; Andriati et al., 2021; Harding, 2021). For example, in congklak, such characteristics can be found in counting seeds, distribution of seeds one-by-one in each hole, trajectory of movements, determination of the final position of the seed, and performing strategic actions depending on the game board. Thus, the evidence above shows that congklak functions not only as a tool for identifying numerical data but also as an action system which can be modeled mathematically. Analyzing it using ethnomodeling makes it possible to develop models based on the cyclical positioning of seeds, discrete distribution of seeds, relationships between holes, and state transformations during the game. In other words, congklak can be viewed as a local mathematical practice with an operational format, inner logic, and formalizing capabilities.

Such an analysis opens a niche that needs to be explored since there is still a relative scarcity of scientific articles which proceed from investigating the culture of the traditional game up to developing its mathematical models. Many studies identify the existence of mathematical concepts in the game and fail to provide detailed information regarding mathematical models underlying game mechanisms (Fouze & Amit, 2017; Laraki et al., 2019). Therefore, the current paper will take a more proactive approach by investigating congklak as a local mathematical practice and developing its mathematical representation based on the ethnomodeling framework. Within this context, the literature review conducted at this stage highlights three basic principles: ethnomathematics as a theoretical base for recognizing culturally grounded mathematical knowledge, ethnomodeling as a methodological framework for formalization, and congklak as a cultural product with mathematical structure allowing modeling.

METHOD

Research approach

This paper adopts a qualitative method that makes use of the interpretive ethnography design. The adoption of this design is informed by the nature of the research to understand congklak as a cultural practice that embodies mathematical logic, rule and procedures within games. The use of the ethnography design will allow for capturing the manner in which participants make meaning of rules, distribute the pieces, make moves and estimate where they end up using local wisdom. In this regard, congklak is seen not only as a game, but a cultural practice that involves the use of mathematics that needs to be interpreted from the point of view of the cultural people. This is inline with ethnomodeling, which views local practices as sources of mathematical knowledge that can be captured using a dialogic model of emic and etic approaches.

Participants

The research participants were individuals who knew the rules of the congklak game and were used to playing the game within their socio-cultural environment. Selection of participants was based on certain characteristics like knowledge of the rules of the game, ability to explain how the game is played, and readiness to play the game. The unit of analysis went beyond the individual player to include playing techniques, tools used in the game, patterns of seeds distribution, movements, and rules for determining moves. Therefore, data was in the form of verbal accounts and actions taken while playing the game.

Data Collection

Data collection methods involved direct observation, semi-structured interview, visualization technique, and artifact analysis. Direct observations involved recording the entire process of the game, focusing on the distribution pattern of pieces, move sequence, initial and final positions, and strategic decisions taken in a particular situation. Semi-structured interviews focused on getting an emic perspective on rule interpretation, selection of holes based on a certain strategy, estimates of piece distribution, and meaning associated with the strategies used. Visualization involved taking pictures and drawing schematic diagrams of congklak board as well as documenting piece distribution from one hole to another. In regard to artifact analysis, efforts were made towards understanding the structural aspect of congklak, such as the number of holes, role of the granary, total number of pieces, and board layout as the foundation of a mathematical model.

Instruments

The primary tool used in this research is the researcher herself, supplemented by an array of observation tools, interviewing guidelines, seed distribution sheets, and game documentation templates. The observation tools were designed to uncover the mathematical concepts displayed through the course of playing the game, which include counting, one-to-one correlation, sequencing relationships, cyclic nature, and identifying final position. The interviewing guideline is intended to extract the reasoning process involved in playing the game. The seed distribution sheets were used to document the order that the seeds fall at every phase of the game, thus turning the empirical data into a mathematical model.

Data Analysis

The process of data analysis occurred in three main phases, namely emic analysis, etic analysis, and dialogic analysis. The first phase, emic analysis, involved the examination of observational and interview data on the ways in which players understand and play congklak based on their indigenous knowledge. The second phase, etic analysis, involved the translation of these processes into mathematical language, including numbering of the holes, discrete distribution, cyclic motion, end positions, and the possible use of modulo operation for describing seed distribution. The third phase, dialogic analysis, involved the synthesis of the results of the emic and etic analyses, leading to the construction of an ethnomodel of congklak – a mathematical model that is rooted in indigenous practices but can be explained using academic language. This method is consistent with the ethnomodeling approach, which highlights the interconnectedness between local, global, and glocal views in the study of cultural mathematics.

RESULT AND DISCUSSION

Result

Congklak as a Cultural Artifact and Game Structure

The first figure shows the main equipment used in the Congklak game: a Congklak board and some seeds. According to the current research, the board used in the game is oval in shape with 16 holes, which include 14 small holes and two large holes at opposite ends. The 14 small holes are placed in two rows, each having seven holes, while the two large holes are the storage place for the two players. The seeds that are used for playing the game can be pebbles, shells, tamarind seeds, or any other small object. In the current research, these objects will be called Congklak seeds. It is worth mentioning that the above physical description determines the course of the game.



Figure 1. The original form of the congklak board and seeds as cultural artifacts that form the basis of the game structure and mathematical representation.

From the perspective of the game's procedures, the game of Congklak starts with setting up the board and seeds. Each small hole on the board will contain the same number of seeds, whereas both the large holes remain empty. In the traditional game, each small hole contains seven seeds,

giving equal distribution on the board initially. Once the board is set up, the players decide the starter. First, a player chooses one of the small holes on their side, picks all the seeds from that small hole, and redistributes the seeds in order in the following holes in accordance with the movement path of the game. Thus, the seeds are sequentially distributed in the other small holes until reaching the large hole on the player's side, without distributing in the other large hole of their opponent. This shows that Congklak follows a sequential order of one-to-one distribution and cyclic movement.

The setup of the board and the rules of the game show a specific pattern based on mathematics. For instance, the presence of symmetric holes in the same rows shows symmetry, the equal filling of the small holes by seeds indicates equal distribution of the seeds, and redistribution of the seeds from one hole to another means sequential counting. In addition, small and large holes on the board mean classification in the gameplay. Hence, Figure 1 is not just the equipment used in a traditional game but also the material manifestation of the mathematical system in the culture. As the concept of ethnomodeling suggests, the board and seeds are cultural objects used in forming mathematical representations.

Position Numbering and the Cyclic Structure of Congklak

As depicted in Figure 2, congklak plays may be described as consisting of ordered and cyclic positions of piece movements. Here, it is possible to number the holes from 1 up to 15; on the other hand, the hole facing the first set of holes is assigned an X, meaning that it does not play the role of a distributor for the current player. Not only is it possible to number the holes as a means of making the process more comprehensible, but such numbering is also used in establishing a mathematical formulation of congklak plays.

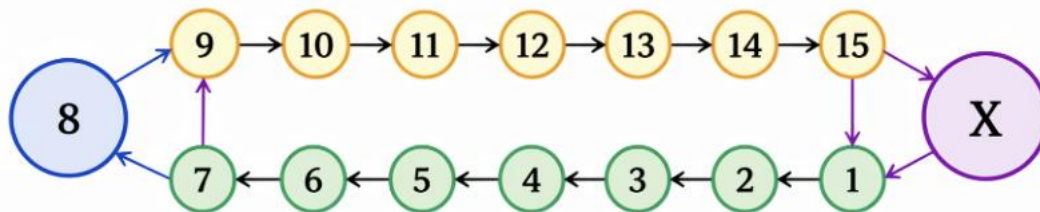


Figure 2. The numbering of positions on the congklak board shows the distribution path of the seeds as a discrete and cyclic position system.

As illustrated in Figure 2, there is only one special case where congklak does not conform to a closed-path rule, namely the case of passing through the opponent's large hole. As stated earlier, this is a crucial requirement under the ethnomodeling approach since it highlights the fact that the game is conducted within an effective position space defined by constraints. In other words, each of the distributed pieces starts at a certain position and ends up at another, based on a one-move-one-position principle, resulting in a system of sequential distribution, one-to-one correspondence, and cyclic recurrence. Hence, congklak can be regarded as a local mathematical

system, whereby counting, ordering, and positional relations are incorporated into a game mechanism.

In terms of the ethnomodeling approach, Figure 2 serves as the transformation from emic practice to etic representation. While congklak players may not always have a sense of formal enumeration of holes, they are aware of the sequence of moves, directions of distribution, and positions that have to be passed or avoided. In other words, the local knowledge involved in playing congklak is encoded into a positional numbering system from an etic perspective. As such, congklak becomes a cyclic positional system, which can be mathematically analyzed using modeling methods. More importantly, Figure 2 forms the basis of constructing an ethnomodel of congklak, especially as far as seed distribution patterns, end positions, and possible sequences-and modulus-based models are concerned.

Initial Position and Distribution Problem Formulation

The first setup in the seed dispersal procedure in congklak is illustrated in Figure 3 below. From this illustration, it can be observed that there is one hole with seventeen seeds and the other holes are considered to be the next positions during the playing process of the game. This formulation becomes important in the sense that it transforms the operational process from the game-playing activity into a mathematical question: given an initial position and a number of seeds, what will be the last position occupied by the last seed?.

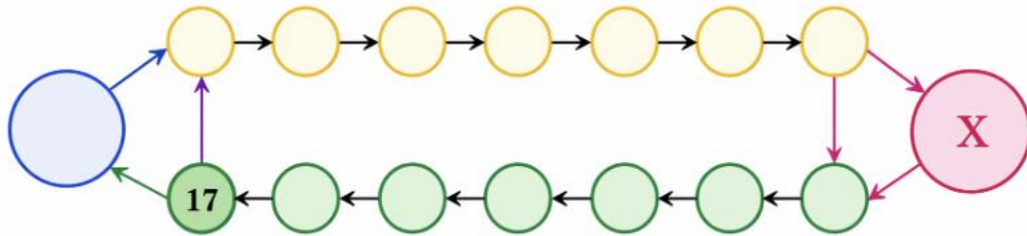


Figure 3. Representation of the initial position of the seed distribution in congklak with 17 seeds as the basis for constructing a mathematical problem.

Under the emic approach, the congklak players do not state their moves in terms of formulae; however, they do understand the principle of distribution in practical terms. The player knows that he must distribute the pieces successively into the next hole in a certain direction, crossing his opponent’s large hole, and reaching the place where the last piece falls. It shows that local mathematics involves the concepts of succession, enumeration, and anticipation of the final position. In other words, the congklak practice is not chaotic but structured, which means that the players follow a specific rule set that an experienced player can predict. Therefore, Figure 3 illustrates not only the practice of playing congklak but also the use of local mathematics in the game.

Ethically, the described scenario can be viewed as the problem of discrete distribution in cyclic positions system. The presence of 17 pieces in one hole suggests that this problem cannot be solved with the help of linear forward counting but requires taking into account the length of

the effective trajectory. Since the cycle of movements in the game operates within a limited set of positions, the seed distribution in the congklak practice can be considered as a cyclic iteration process. In this case, local practice can be transformed into ethnomodel, where the starting hole will refer to the initial position, the number of seeds will correspond to the number of iterations, and the effective trajectory will be represented by an ordered sequence of positions.

Therefore, Figure 3 is the key point in the ethnomodeling process: the moment when we go from the description of artifacts and trajectories to creating a mathematical problem. Indeed, the primary question changes from "How to play congklak?" to "How to represent the seed distribution process in congklak using mathematics?" Moreover, the initial position with 17 seeds becomes an example proving that the cultural practice involves a certain formalized scheme, such as the relation between the initial position, the number of seeds, distribution trajectory, and final position. Figure 3 thus creates a material base for creating a mathematical model in the next stage.

Final Position and Mathematical Representation of Seed Distribution

As illustrated in Figure 4, the final layout of the seeds after redistribution from the starting chamber that initially holds 17 seeds is shown. From the above results, it can be observed that the last seed lands in hole number 8, thus enlarging the player’s larger hole, and each intermediate hole gains a single seed according to the one-to-one distribution rule. As shown above, it becomes evident that the final result of the game does not occur randomly but follows a predictable and orderly sequence. In essence, the final congklak arrangement stems from a mathematical formula built into the game rules.

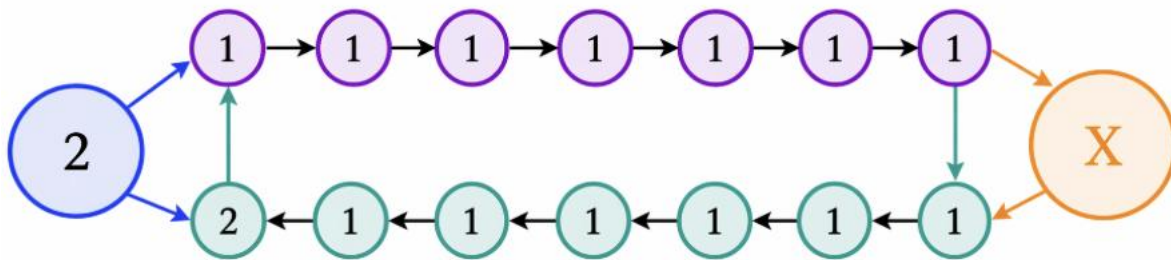


Figure 4. Representation of the final position of the seed distribution in congklak showing the results of movement in a cyclic path system.

At the next level of modeling congklak within the framework of ethnomodeling, Figure 4 describes the process of translating local practices into an operational ethnomodel. Specifically, at the emic level, congklak players understand that a group of pieces extracted from one hole will move in the specified order until reaching the terminal position. At the etic level, this process can be interpreted as a dependency of initial position, number of pieces, distribution pathway, and terminal position. Thus, distributing 17 pieces over the system of 15 effective pathways proves the applicability of the concept of cyclic recurrence here. Therefore, the terminal position is determined not only by the game dynamics but also by the mathematical formalism.

Furthermore, Figure 4 shows that congklak involves a system of state conservation and transformation. While the number of pieces in the system stays the same, their distribution varies depending on the game dynamics and rules, leading to emergence of various board states. Thus, the game involves counting procedures as well as distribution logics, position mapping, and state change operations. Three features described above ensure that congklak is a good subject for modeling since the game can help create a mathematical model of local cultural practices while preserving their essential features.

Moreover, Figure 4 provides evidence about mathematical modeling of congklak: based on the results presented in the figure, it is possible to formulate a formula describing the final position. In case the initial position is designated by p , the number of pieces by n , and the number of effective positions by m , then the final position can be viewed as a result of several moves made along a cycle. Thus, in case of distributing 17 pieces over 15 positions in a cycle, there are two remaining positions, which allow moving from the initial position to the final one shown in Figure 4. Such modeling becomes particularly important since it shows that congklak players rely on local mathematical logics when developing strategies for this game.

Therefore, Figure 4 confirms the key conclusion formulated in the course of the research, namely that congklak represents a traditional cultural practice incorporating explicit mathematical formalism that allows conducting ethnomodeling. As for the final position shown in the figure, it confirms that this game involves the system of sequences, cycles, and transformations that can be considered as mathematical constructs. Moreover, in the context of teaching mathematics, the described results make congklak even more valuable than a contextual traditional game.

Mathematical Modelling of Congklak through Ethnomodelling

This chapter argues that congklak carries implicit mathematics concepts and that it allows explicit representation as a mathematical model of cycles. In the case of ethnomodeling approach, modeling starts with the cultural practice of congklak as perceived by the practitioners and moves on to the formal model, which is a faithful representation of cultural logic. Therefore, the modeling carried out here does not aim at replacing local practices by school mathematics but rather to explain the mathematical principles that operate in these local practices. Another contribution made by Rosa & Orey (2019, 2021) shows that ethnomodeling is indeed a translation of the local mathematical practices into formal models through emic/etic/dialogic relations.

1. Congklak as a discrete cyclic system

Based on the distribution pattern and rules of congklak, the congklak game can be defined in terms of a system of discrete and sequential positions. The holes on the congklak game board serve as the positions, while the movements of the balls follow an invariant pathway from one position to the next position. Under such a scenario, the large hole of one player is considered to be one of the 15 positions, while that of the other player is disregarded, as it does not contribute to the distribution process of the balls. The congklak game system, therefore, takes the form of a closed loop system of 15 positions within the context of a single distribution cycle. Hence, the congklak game qualifies to be regarded as a cyclic system, since after

reaching the last position, the distribution process loops back to the first position of the pathway.

If the set of effective positions is expressed as:

$$P = \{1,2,3, \dots, 15\},$$

So each distribution step is a movement from one element of the set P to the next element in sequence. In this sense, congklak works as a position mapping system.

$$T(p) = p + 1(\text{mod}15),$$

with p denoting the current position. This model shows that the local game rules that players practically follow can actually be expressed as cyclic displacement operators.

2. *Initial position and final position model*

The essence of the distribution process in congklak lies in the relationship between the starting position, the number of seeds, and the ending position. For example:

- p = starting position,
- n = the number of seeds taken from one hole,
- m = many effective positions in the game track.

Because in this model the effective path consists of 15 positions, then $m=15$. The final position of the last seed can be expressed by the function:

$$E(p, n) = ((p + n - 1) \text{mod} m) + 1.$$

This function explains that the final seed is not determined by guesswork, but by a consistent mathematical relationship between the starting position and the number of distribution steps. In the examples in Figures 3 and 4, the distribution starts at position 6 with $n=17$. Since:

$$17 \text{mod} 15 = 2,$$

then the effective displacement only leaves two steps after one full rotation. Thus, the final position can be determined through:

$$E(6,17) = 8.$$

These results are consistent with the visual model presented in Figure 4, and confirm that players' locally constructed strategies for predicting the position of the seed's last landing point can be explained using modular arithmetic. With respect to ethnomodeling theory, the equation represents the players' empirical knowledge in mathematical form.

3. *Distribution model as a state transformation*

However, congklak goes beyond the end position to include a complete rearrangement of the configuration on the board. Thus, the game is best thought of as a change in the state of the system. Let us call the state of the board:

$$\mathbf{x} = (x_1, x_2, \dots, x_{14}, L),$$

with:

- x_i states the number of seeds in the i -th small hole,
- L states the number of seeds in the player's big hole.

In the case where the chosen hole is $x_p = n$, then all the seeds in this hole will be extracted and, thus, making $x_p = 0$. The next step involves placing the n seeds one after another into subsequent holes using the path rule provided.

$$\mathbf{x}' = F_p(\mathbf{x}),$$

Where F_p refers to the transformation function that maps the starting state to the resulting state after one move in the game. The importance of this model lies in its ability to show that congklak is indeed a discrete dynamic system where the progression of states follows strict, structured, and predictable guidelines. Therefore, it may be considered that the cultural phenomenon of congklak is not only an act of counting but a well-defined transformation function.

4. *Seed number conservation model*

A significant feature in congklak is the fact that the number of seeds remains constant throughout the game system. There is no production or destruction of seeds in the game as seeds are only shifted from one position to another:

$$\sum_{i=1}^{14} x_i + L_A + L_B = C,$$

with C representing the total number of seeds that is constant throughout the game. If at the start of the game each small hole is filled with 7 seeds, then the total number of seeds is:

$$14 \times 7 = 98.$$

As a result,

$$\sum_{i=1}^{14} x_i + L_A + L_B = 98.$$

This model shows how congklak entails aspects of distribution, positioning, and a principle of numerical equilibrium. In view of ethnomodeling theory, this means that the rules which govern the game have a consistent and reliable mathematical foundation.

Discussion

Indeed, it can be concluded that the research findings confirm that congklak should not be considered solely as a traditional game involving counting, but also as a system of mathematics that operates according to certain laws. In particular, board structure, sequence-based distribution algorithms, closed routes, prohibition of opponents' barn, as well as regular final position states suggest that congklak involves the use of sequences, cycles, one-to-one correspondence, quantities conservation, as well as the state transition. The major strength of the current study consists in the approach to analyzing congklak, which implies moving the emphasis of analysis from the search for mathematical components to the elaboration of the ethnomodel of congklak. From this point of view, the present paper follows the approach developed by Rosa & Orey (2019, 2021), according to which ethnomodeling represents the connection between ethnomathematics and modeling by translating local mathematical practices into formal representation.

In other words, the scientific significance of congklak can be seen in the internal mechanisms of the game rather than in cultural aspects of its perception by people. Many scientific works on traditional games come up with the description of different concepts related to these games, including, e.g., arithmetic operations, sequences, probabilities, etc. The work dedicated to Tong Tong Galitong Ji was no exception, since the researcher succeeded in identifying basic arithmetic operations, modulo arithmetics, arithmetic sequences, and probabilities. However, the main focus of the investigation consisted in identifying the mentioned concepts as a product of playing a game. By contrast, the current work extends the scope considerably. Congklak is perceived not as a context for appearance of mathematical concepts, but also as a system of discrete distributions, involving cyclic routes and formal representations.

First of all, from a theoretical point of view, these results strengthen the claim that ethnomodeling involves the dialogic relationship between emic knowledge and etic representation. Players of congklak do not use such concepts as "modulo", "position function" or "discrete system"; however, they implement all of them successfully in their gameplay. That is why the importance of ethnomodeling consists in the fact that local knowledge cannot be considered as mere pre-mathematical illustration; on the contrary, it represents a structured type of reasoning which will later be formulated in academic terminology. As it was stated by Rosa & Orey (2019, 2021), ethnomodeling stands for a glocal phenomenon where local mathematical practices are used as the foundation of learning in emic, etic and dialogic relationships. Unlike the examination of Brazilian farmers' market conducted by de Oliveira Cortes and Orey (2020) who proved that relations of prices and farmers' experiential knowledge may be formulated into dialogic ethnomodels, the present paper proves that congklak game logic can be transformed into a mathematical one, preserving its cultural origins at the same time.

This paper adds some more food for thought to the discussion on the role of traditional games in math education as well. It is commonly known that traditional games help to mobilize mathematical and scientific knowledge while strengthening the awareness of cultural legacy and intercultural values. However, numerous studies in traditional game-based education tend to regard games only as didactic means, and not as local knowledge about how mathematics works. On the contrary, the current study shows that congklak is much more than just an educational tool; this traditional game contains certain epistemological objects including distribution models, path rules

and logic of prediction. Therefore, the importance of this study goes beyond recognition of the potential of traditional games as educational media; the results prove that these games can become the basis for the formulation of such formal concepts as modulo, cyclic systems, state representation and conservation of numbers.

Finally, the practical value of these findings should be mentioned. The fact that students learn concepts such as sequences, discrete distributions, modulo and state transformations using congklak implies that they learn from cultural practices that already have a certain internal mathematics, not from isolated formulas alienated from life experience. Such a conclusion fully conforms to literature which claims that traditional games and local cultural artifacts provide a unique opportunity to make connections between daily experiences and the school mathematics curriculum. At the same time, the importance of this paper lies in another aspect, namely in the assertion that introduction of culture in math learning would remain superficial without the process of modeling.

In the present case, the results point to contributions at three levels that are inherently interrelated. At the conceptual level, the study contributes to support the idea that ethnomodeling is a more appropriate concept than descriptive ethnomathematics as a tool for analyzing indigenous games. At the analytical level, the study proves that congklak can be characterized as a cyclic discrete system with interrelations between the initial position, number of seeds, their distribution, and position after movement. At the pedagogical level, this example shows that indigenous cultural practices can be successfully integrated into academia without damaging their unique character through highlighting their mathematical nature.

CONCLUSIONS

Conclusion

The present study reveals that congklak does not only constitute a traditional game involving the process of counting but a mathematical practice in its local setting, characterized by a certain operational structure, inherent logic, and representation, which could be considered valid and possible through ethnomodeling. Through the analysis of the game objects, trajectories of distributions, positions, and changes in the arrangement on the board, the study provides evidence that congklak involves a counting process, distribution, cyclical pattern, positioning, quantity conservation, and prediction of outcomes, all of which may be modeled mathematically. In particular, the main achievement of the study is seen in the shift from the descriptive view of ethnomathematics towards the construction of an ethnomodel, representing the process of translation of congklak practices from the emic level to etic representations through dialogical relations between these two aspects of mathematical knowledge. Therefore, this study supports the legitimacy of local culture as a source of mathematics knowledge, while at the same time emphasizing that mathematics learning based on cultural context becomes relevant only as a step to creating models.

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