Pop: The Ethnomathematics of Globalization Using the Sacred Mayan Mat Pattern

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Introduction

Ancient people knew of others through myth, legend, and the stories of conquerors or travellers. Living in isolated groups, most people and lived and died in the same place (Toffler, 1980). Recently, the world's peoples have been linked together through extensive systems of production, trade, communication, and migration.

The Globalization of Mathematical Knowledge

Earliest observations of distinct mathematical practices occurred along with the earliest travels. Observations of the customs and mathematically-related practices, such as counting allowed early philosophers to apply many "new" mathematical concepts and ideas. The development of writing also allowed scholars to piece together knowledge accumulated by early civilizations. Currently, an increasingly sensitive understanding of mathematical practices used by diverse groups has become available.

Ethnomathematics and the Process of Globalization

There are many different kinds of ethnomathematics (D'Ambrosio, 1985). Each one responded to different cultural, social, and natural environments, one form originated in the Mediterranean basin and gave origin to a form of ethnomathematics called *mathematics*. Through processes of conquest and colonization, and now a corporately forced globalization, "mathematics" has imposed itself worldwide. Accompanied by a colonial world view of property ownership, production, labour, and consumption, and subsequent capitalistic values, western mathematics has had tremendous success.

However, the distinction between western and non-western mathematics is weakened by a theory of knowledge supported by a cultural dynamics occurring when different cultural groups encounter each other, produce, generate, organize, transmit, and diffuse knowledge. So it is that western mathematical practices are a form of ethnomathematics defined by the cultural background and patterns of the individuals and institutions that practice them, that translates this

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knowledge in a form of academic language and incorporate it as mathematical practice in their daily lives (D'Ambrosio, 2000).

The Mayan Civilization and the Process of Globalization

Mayan civilization survived for more than 3000 years in Central America and is best-known for its distinct architecture, patterns that were found in their observations about the universe, the development of mathematical relationships, and a symbolic and sacred system that they developed to represent these patterns and relationships. About 7 million Mayan people are dispersed in urban and rural communities in Southern México, Belize, Guatemala, Honduras and El Salvador. After centuries of persecution, cultural insulation, and disrespect of Mayan traditions, beliefs and religion, most Mayan people now live in crushing poverty (Wilkinson, D., 2002).. For indigenous Mayan people, the violent encounter with globalization began in 1524 with the arrival of the Spanish conqueror Pedro de Alvarado. With the invasion of the Americas by Europeans, much of the world of the Mayans, Incas, and Aztecs, like all the other Indigenous societies in the Americas, came to an abrupt and brutal end.

Although medieval Europe was in many ways less developed than the Mayans, the conquerors arrived with an enormous advantage: diseases, gunpowder, steel swords, and horses. European religion, technology and firearms were used to justify their "destructive acts on the basis of cultural superiority" (Ascher, 1991, p17). When the Mayans were defeated, the invaders also destroyed libraries that were possibly the greatest repositories of indigenous science in the Western Hemisphere. There are just a few surviving texts. Among them is the hieroglyphic source for the *Popol Vuh*, which is considered by some to be the "Mayan Bible", and the Dresden Codex, which revealed a glimpse into the sophistication of Mayan knowledge, astronomy, and mathematics.

When Mayan cities were sacked, their religion and culture were banned and forced underground. Mayans were enslaved and were deprived of there own property, land, and rights. Despite centuries of oppression and prejudice, Mayan people continue to produce and use traditional weavings, celebrate cultural and religious ceremonies, and maintain and speak their own languages. Mayan culture has been weakened due to the processes of colonization and globalization. The early greed and ambition of colonizers has been replaced by the phenomenon of globalization resulting in increased social deprivation and degradation.

The Geometric Pattern of the Mayan Diamond Pattern

The Mayans made use of a series of sacred geometric-numeric patterns that they transmitted from generation to generation. The utilization of these patterns probably originated with a species of snake *Crótalus durissis* (Nichols, 1975; Diaz, 1995; Grattan-Guiness, 1997). The snake possessed a skin with a unique diamond pattern; this particular species is called the "diamond backed rattlesnake" (Fig. 1). The contemplation of this form and geometric pattern inspired Mayan art, geometry, and architecture (Diaz, 1995, Grattan-Guinness, 1997). Because *Crótalus durissis* "crawled its way across time" rattlesnake images came to symbolize birth and life changes. Significant patterns found in geometric rattlesnake forms are found in the fabrics and façades of ancient buildings, monuments and architectural structures (Fig. 2).
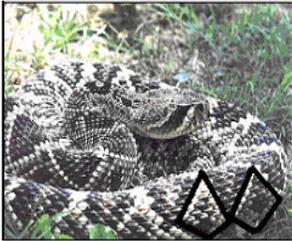
Figure 1: *Crótalus durissus*

Figure 2: Rhombus representing the geometric form on the skin of the rattlesnake

The degrees of slope of Mayan pyramids are extremely steep and difficult to climb (Fig. 3). The easiest way to climb Mayan pyramid stairs is to climb the steps in a zigzag trajectory. Lines of ascending and descending priests would have formed the same geometric patterns as found in the rattlesnake skin (Diaz, 1995; Grattan-Guinness, 1997).

Figure 3: El Castillo in Chichen Itza

The Sacred Mayan Mat

The word *Popul* in the title in of the sacred book *Popul Vuh* contains the prefix *Pop (Ahpop)*, that is the Maya Quiché word for *mat* (Recinos, 1978; Diaz de Castillo, 1983). Mayan pyramids sat on top of mat or number values which provided a spiritual foundation to buildings. As well, priests and nobility sat on *mats.* The first encounters made between Spanish and Mayan

leaders, the Spanish leaders were encouraged to sit on mats offered by their hosts, which contained values and a negative power that were used to withhold any blessing to their conquerors.

Figure 4: Different Geometric Patterns of the Sacred Mayan Mat

Mat patterns were and are still sculpted in stone, jewellery and cloth. Through much of their weaving, the present *power* of designs and vestments are connected with customs and ceremonies once promoted by their ancestors.

Figure 5 Wall of a Mayan Temple in the Yucatan, México

The diamond mat form was in accord with sacred numbers of the Gods; it was divine power that implied the numbers of 1 to 9 (Nichols, 1975, Orey, 1982). This context allowed Mayans to use numbers imposed on the patterns as a form of numerology with sacred values and significances (Coe, 1966, Coe & Kerr, 1988; Nichols, 1975, Orey, 1982).

1.	God or Goddess
2.	The Creator. Parents
3.	Creature and Life
4.	Venus, called Kulkulkan
5.	Priest : The Hand of God
6.	Life and Death
7.	God in Divine Power
8.	Body and Soul
9.	The Nine Drinks

Table 1: The Sacred Significance of the Numbers

Decoding Mayan Messages

Nichols (1975) demonstrated how the X^1 patterns found on mat patterns contained information. The numbers placed on these mats progressed sequentially and zigzagged diagonally. The first number is positioned on the right vertice of the first square that composed the mat. For example, on a mat of 3 lines by 2 columns, the numbers are placed as in the diagram below:
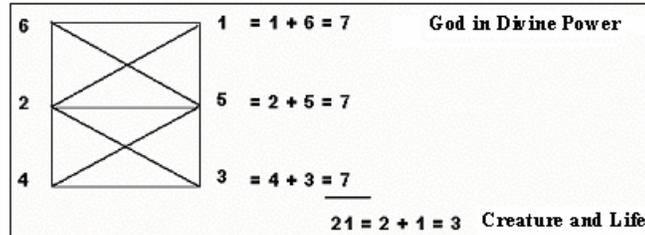
Figure 9: Decoding Mayan Messages

The final numerical number of this matrix might be calculated in the following manner:

1. Add the corresponding numbers of each line of the matrix.

$$1 + 6 = 7$$
$$5 + 2 = 7$$
$$3 + 4 = 7$$

Consulting the table 2, the result 7 has the value: God in Divine Power.

2. Adding all the results we get:

$$7 + 7 + 7 = 21$$

3. Then add the digits resulting in the ultimate value of: $2 + 1 = 3$

4. According to the table 2, the number 3 corresponds to Creature and Life.

A possible interpretation of the message of this result can then be: *God utilizes His Divine Power to give life to all creatures in the world.* So it was that priests may have made decisions based on mats containing *ultimate values* for each pattern. For example, to find a solution for a given situation, a priest needed to make a decision towards codifying a mat that contained the ultimate value 6 which signifies "Life and Death."

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[1]According to Girard (1979), "when the King spreads his legs and lifts his arms over his head, he assumes a posture that can be called a cross and which is nothing more nor less than the representation" (p. 293) of the glyph of kin or glyph of the sun.

The Mayan Number System of the Divine Creation

The creation of the world was closely associated with mathematical concepts. The Quiché codex begins by referring to the creation of the universe. That is,

> Divinity – pre-existent to its works – creates the cosmos, which extends through two superimposed, quadrangular planes – heaven and earth – their angles delimited and their dimensions established. Thereby is established the geometric pattern from which will derive the rules for cosmology, astronomy, the sequential order in which events occur, and the marking out and use the land, which for the Maya are all reckoned from that space-time scheme. (Girard, 1979, p. 28).

The creation of the four corners of the Mayan universe were governed by geometric patterns of the rhombus which represents the geometric pattern on the skin of *Crótalus durissus* (Diaz, 1995). The god Tzakol[2] used supernatural intervention in the creation process by applying the sacred-symbolic power of the numbers as described in the book *Popol Vuh* (Recinos, 1978; Diaz, 1995).and is interpreted using the following mathematical patterns:

Zero - This is the first account, the first narrative. There was neither man, nor animal, birds, nor forests; there was only the sky. … Nothing existed (Recinos, 1978, p. 81). It was like a seed phase because all was in suspense, all calm, in silence, all motionless, and the expanse of the sky was empty. A seed symbol ⬯ was used to represent zero.

Number 1 - *Tzakol*, known as Huracán, is the first hypostasis of God. He planned the creation of the universe, the birth of life, and the creation of man.

Number 2 - The Creator brought the Great Mother (*Alom*) and the Great Father (*Qahalom*). *Alom* represents the essence of everything that is conceived, and *Qahalom* gives breath and life.

Number 3 - Then came the three: *Caculhá Huracán* (the lightning), *Chipi-Caculhá* (the small flash) and *Raxa-Caculhá* (the green flash) that represent life and all creatures.

Number 4 - Venus, called *Kukulkan* is represented by number 4 which corresponds to the sides of a rhombus and is the design of the skin of the rattlesnake..

Number 5 - The gods delegated their power to the priests. The priests were considered as the hands of the god because they gave to the Mayan people the gods' answers to their prayers. In Mayan ceremonies, the priests held ceremonial rods decorated with rhombuses in the centre and a snake head on top and they were "the mathematical insignias of the wise priests that ordered the construction of the Mayan temples".

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[2] According to Diaz (1995), "the root of Tz'akol is Tsa or Tza, that is Tzamná or Itzamná, which comes from Tzab, rattlesnake, which is onomatopoeic with the sound of the rattle" (p.8).

Number 6 - Bones are like seeds because everything that dies goes in the Earth and then new life emerges from the Earth in a cycle of existence.

Number 7 - The Mayans believed that the divine power of the gods reorganizes the order of the cosmos and reunites the human world with the supernatural and mystical worlds.

Number 8 - Everything on and of the Earth relates to material reality (the body) and spiritual reality (the soul).

Number 9 - *Alom* made nine drinks with the milling of yellow and white corn. With these drinks she created the muscular body and the robustness of men.

The Symbolism of Mayan Numerology

To ancient Mayans, natural events occurred in accordance with numerical patterns, as in the annual sequence of the lunar cycles. Numbers were related to nature and for this reason it was possible to determine that the universe obeys laws that allowed them to measure and anticipate certain forms of natural events. The Maya can be said to have "mathematized" time, and, through it, their religion and cosmology" (Ascher, 2002, p.63). With this advanced mathematical knowledge, they incorporated concepts of theogony[3] with concepts of numbers by utilizing symbolic elements to express their ideas about creation and the universe. Mayan theology posited nine attributes of God. These philosophies related to numbers of their abstract manifestations and were used to explain, understand, and comprehend organizational principles of the universe.

Final Considerations

The focus of this study was on Mayan ethnomathematics. In so doing the authors attempted to understand how Mayan scholars understood and organized a part of their mathematical knowledge. Through the development of a sacred number system using mats with divine patterns. Mayan people possessed a sophisticated geometric and numerical creation story of their universe, whose first record is related to sacred numerical values. Numbers, symbols, and words could direct the priests to corresponding numerical values. A study of Mayan practices demonstrates one use of an ethnomathematical - global perspective. Ethnomathematics serves as an academic counterpoint to globalization, and offers a critical perspective to the internationalization of mathematical knowledge through attempts to connect mathematics and social justice. It is also possible to perceive ethnomathematics as the academic articulation

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[3] The genealogical account of the origin of the gods.

between cultural globalization of mathematical knowledge and diverse non-Western cultural groups.

When discussing, sharing, and internationalizing mathematical practices used by other cultures, it is necessary to recast them into an individual's Western mode or understanding. Mathematical modelling allows us to translate these practices into western mathematics. In this cultural dynamism it is possible to distinguish between the mathematical practices and ideas which are implicit and those which are explicit, between western mathematical concepts and non-western mathematical concepts which are used to describe, explain, understand, and comprehend knowledge generated, accumulated, transmitted, diffused, internationalized, and globalized by people in other cultures.

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