The use of numbers in embroidery in tzeltal mayan communities

Miriam Moramay Micalco Méndez
PhD Candidate. Department of Educational Research, Center of Research and Advanced Studies of the National Polytechnic Institute, Mexico

In Mesoamerican civilization, especially in the Mayan culture, numbers are an expression of a world view and not only a tool for making calculations, which is in contrast with the way of conceiving and using numbers in Western societies, where they are considered almost exclusively as an aid for calculating and modeling reality. Investigation of the use of numbers in the everyday life of Tseltal Mayan communities from an ethnographic standpoint helps us better understand quantitative relations as culturally and historically situated social practice. This article presents an analysis of the use of numbers by Mayan women embroiderers that points to several cognitive and sociocultural dimensions involving specific cultural meanings related to the Mayan cosmovision. Of particular relevance are those meanings that directly refer to the heart and that which is sacred. The descriptions show how through their everyday use of numbers embroiderers express and participate in a longstanding Mayan social and cultural cosmovision. In the same way, the construction of the names of numbers reflects this cosmovision, and they take into account some elements of the community's organization and even the name of the gods and the corporal dimension.

Keywords: culture, mathematics, relations of quantity, cosmovisьion, heart.

Introduction

This paper shows how the names of numbers have been constructed and how through the use of numbers Mayan embroiderers express and keep alive a Mayan cosmovision. I argue that in this case the use of numbers is not adequately understood: it has been seen as simply a mathematical tool used for utilitarian calculation. Multiple dimensions come into play in the use of numbers, not only the cognitive and social dimensions, but also affective, emotional, corporal, symbolic and spiritual dimensions. Consideration of all these dimensions, and not only the cognitive and social aspects, is important in mathematical education.

Further, a careful look at everyday math practices in different social and cultural settings can shed light on differences between cultures and civilizations that are often either invisible or misunderstood. Some crucial differences can be found in the epistemological and ontological domains. Each civilization has its own set of principles or criteria that people use to guide themselves and make sense of their daily lives. These principles refer to basic kinds of knowledge that support the common actions of daily life, knowledge that has been constructed in different ways by different societies and that is reconstructed anew as part of the ongoing activities of everyday life. As will be seen, everyday math represents a particular kind of culturally grounded knowledge that includes a conception of human-self.

Therefore, when people need to know a different culture or civilization, their first instinct is to try to find the references in their own civilization in order to know the other civilization. This situation brings with it some kinds of comprehension problems. The recommendation is to recognize our differences and open the mind to know more clearly the new aspects of the civilization in question. "It is necessary to start from the idea that understanding the world is much broader than just understanding the Western world. And that is the quid: there are other ways of seeing the world" (De Sousa, 2010).

Similarly, one could also say that there are many ways of counting. Before beginning this study, I worked at the mountains of Chiapas, in the south of Mexico, at one of the schools of the Mayan Tseltal region. The secondary school's students worked in teams on algebraic problem-solving in the mathematics course. They solved the problems in a very particular way. One problem had proportional propositions about two kinds of animals that belonged to children. The students represented the animals with two kinds of seeds. They organized the material in order to represent the proportional number of animals in reference to the body. All of the teams represented one pig with four seeds and one chicken with two seeds. It was very particular because they had two different kinds of seeds; they could have utilized a different seed for each kind of animal. I asked them why they used this organization of seeds to represent the animals. They said, "Because the pig has four legs and the chicken has two." This answer allows us to recognize that the use of numbers has a connection with the body. As we shall see, the Mayan numerical system has been constructed with references to the body in a specific cosmovision and with a base of twenty.

After this experience and other similar ones, I formulated some research questions: What are the social practices in which the Mayan numeration is involved? What

are the meanings that support and develop this numeration?

From these questions we began this study, and we found Mayan Tseltal mathematics is a construction of the vision of the world instead of just a tool for calculating. In this way, Mayan mathematics makes it possible to understand the world in concrete situations in everyday life, but not only as an abstract concept.

We need to consider historical aspects in order to understand the meanings of numbers in the social practices of Mayan people. The Mayan civilization lived in the Anahuac Empire since 2800 b.c. among another ethnic groups. In 1521, the Spanish conquest decimated the native population. Three centuries later, the nation of Mexico declared its independence. In this process, the voice of the native peoples was not included (Hernandez, 1998). At the present time there are 14,092,248 indigenous people in the country[1]; 12.54 % of Mexico's 112,322,757 million inhabitants[2] are indigenous. In the state of Chiapas there are 1,533,756 indigenous people[3]; they represent 29.4 % of the state's population. Their educational programs use the Western approach which does not consider their cultural knowledge.

This study was conducted in Southern Mexico, in the state of Chiapas, in three communities: Guaquitepec, Chuch'tel, and Nuevo Progreso. I did participant observation in different activities of the community: rituals and celebrations, community meetings, housework and field works, and economic exchanges. I conducted semi-structured interviews with children, youth, adults and old men and old women. I worked in three specific places: the corn and coffee plantation, the town markets, and workshops where the women embroiderers worked. I chose these places because I could see that numbers played a key role in these activities.

Theoretical perspectives

In order to do the analysis of the data, we wanted to define some relevant concepts that would help identify and define the historical sociocultural perspective that has guided this research effort and analysis process. We can only understand social practices within the terms of a culture that has a specific "cosmovision" or vision of the world. If we follow Geertz's approach, we consider culture in the semiotic sense as a "warp" where people live in a network of meanings that they themselves have constructed. Furthermore, culture analysis in social sciences must be an action that looks for meanings, not only laws, as experimental sciences do.

Culture denotes a historically transmitted pattern of meanings represented in symbols, a system of inherited conceptions expressed in symbolic ways and means by which men communicate, perpetuate and develop their knowledge and attitudes towards life (Geertz, 1987; pp. 20).

In this sense, the role of symbols is to facilitate communication between those who share them, giving meaning to the experience that is shared. However, many aspects of cultures are shared. Each culture emphasizes and elaborates particular symbols and meanings. One symbol can have a specific meaning in one place, and a very different meaning in another place. This aspect shows that members of different cultures would not share the same meanings or the different symbols, as learned in their family and community life. These meanings are not static and rigid, but are transformed in the course of history, in a double movement in which the culture enriches itself with new contributions from members of the culture, while at the same time reproducing values that were received from the ancestors. Cultural analysis is situated in this domain as a tool to find changes and continuities in the life of human groups.

The cosmovision of a people has to do with its culture's cognitive and existential aspects, not only moral and aesthetic values (Geertz, 1987). Thus, the cosmovision is a portrait of how things are in their pure effectiveness. It is the person's, or the society's, conception of nature. It contains a people's general ideas of order.

The cosmovision is order, language and law, but it does not need to be formalized. It does not even need to reach the consciousness of its creators to be erected, communicated, and to show the way. Even if the worldview is never expressed in a global and systematic way, it is possible to discover its principles and paradigms, and to see how they move daily life (Lopez Austin, 2005; pp. 68).

In this article I will present one of the ways in which Mayan mathematics is present in everyday life, understanding everyday life as the actions people carry out to meet their essential needs on a day-to-day basis. These actions are generally related among themselves and to the actions of others, and through them a network of relations is knit, a network of social practices.

Another theoretical perspective that has guided this research is the theory of social practice, a theory of relations in which theoretical and empirical efforts are mutually constitutive and cannot be separated. In this case, social practices reveal which items are to be reviewed thoroughly to achieve a very specific research objective.

Following Lave (2011), this study then looks at specific social practices in Mayan communities that involve the use of numbers. I will attempt to show how the use of numbers and quantitative relations involved in every-

[1] Consejo Nacional de Población (2011). Informe: de la Población Indigena de México 2000—2011. http://www.conapo.gob.mx/index.php?option=com_content&view=article&id=37&Itemid=235. (Is there a reason for presenting some references in footnotes and others at the end of the document?)

[2] Instituto Nacional de Estadistica y Geografia (2010).http://www.inegi.org.mx/inegi/contenidos/espanol/prensa/comunicados/rpcpyv10.asp

[3] Consejo Nacional de Población (2011). Informe: de la Población Indigena de México 2000—2011. http://www.conapo.gob.mx/index.php?option=com_content&view=article&id=37&Itemid=235.

day life can lead to an understanding of Mayan math as a particular historically situated sociocultural practice. Such practices only make sense when they are carried out as part of a social practice that is ongoing; "relations of quantity only had meaning as part of ongoing practice" (Lave, 2011:119).

Critical Ethnographic Approach

The ethnographic approach in this study is based on the tenets of critical ethnography proposed by Lave (2011), which place social practice in the center of analysis, and the work of ethnography looks at the whole question from a historical materialist approach based on Marx's theory of praxis. However, Marx cannot be understood without Hegel. That is the reason that we have taken Hegel's postulates as a methodological and historical reference for doing a dialectical analysis and achieving greater understanding (Hyppolite, 1968). The critical ethnographic approach is based on a dialectical movement between concept and reality.

Following Geertz (1987), we considered analysis as a movement that consists in unraveling structures of meaning. A cosmovision is a set of meaning structures grouped in a complex whole, which takes shape in social practices carried out by members of a group. Therefore, the method of analysis that I propose in order to unravel the meanings of the cosmovision is to follow the dialectical movement in order to explain the relations between various categories. From the dialectical movement between the categories in question, it is possible to identify the relations between them and even to construct a synthesis. Ethnographic practice involves mapping a beautiful landscape to be admired in all its dimensions (Commaroff and Commarroff, 2003).

Mesoamerican Cosmovision

The work done by anthropologists, historians and archaeologists show a close relation between the use of numbers by the ancient Mayans and their present-day use in Mayan Tseltal community social practices. Furthermore, there are clear indications of a world view underlying these practices, a world view closely tied to a cosmovision that has been identified as part of Mesoamerican civilization (López Austin y Millones, 2008; Lenkersdorf, 1999; León Portilla, 2007; Bonfil, 1988), and different from a Western world view grounded in Western civilization.

The Mesoamerican cosmovision, the Mayan included, is founded on the projection concept, with the world as a receptacle of divinity. In this sense, Mesoamerican peoples do not divide the world into the Sacred and the Profane. They consider that the origin of the world was a movement of projection on all the things created, even on human beings. Projection it is not the same as representation. It is the movement in which the divine essence takes place inside of all things in the physical and non-physical domains. The Mayan cosmovision is grounded in this concept. (López Austin, 2005; León Portilla, 1992).

For the Mesoamerican peoples the divinity has three fundamental elements that are projected in the four cardinal points (north, south, east, west) and in the heart of human beings when they are born. These elements are: The Mount, The Sacred Cave where groundwater is, and The Three (López Austin, 2005). The Mount symbolizes the earth as a place where all human beings live. The Three symbolizes everything on earth, for example plants, animals, stones and human beings. The Cave symbolizes the place where the ancestors live. The ancestors are active members of the community because they live on after they die. The ritual for a good harvest of corn, coffee and beans is directed to the ancestors.

There are other prayers addressed to the ancestors in order to facilitate other kinds of activities inside the community, for example health, education, transportation, etc. The use of numbers in the activities of everyday life is directly related to the cosmovision's concepts.

Numbers in the Mayan world

Numbers are one expression of the world in Mayan numeration. The construction of the names of the numbers follows the principles of the Mayan cosmovision; they take into account some elements of the communities' organization and even the name of the gods and the corporal dimension. This aspect shows the relation between the name of a number and the most important beliefs and traditions in the daily life of Mayan people.

The first twenty numbers have two dimensions that refer to two numbers: 20 and 13. On the one hand, the names of the numbers have a relation to the body (1—20), and on the other hand, the names have a relation to the gods (1—13). In the first case, the body is the principal reference for counting.

The action of counting is an everyday practice in several activities in Mayan communities. Mayans use the names of the numbers to count and they do it with respect if the elements they must count have a relation with corn, as the following example shows.

I observed this relation of respect for corn when one day an old woman counted some corn seeds with her granddaughter. The old woman was in the kitchen with her daughter and her granddaughter. She stumbled when she had her hand in a little basket of corn: and some corn fell onto the dirt floor. The corn was mixed with loose soil. The girl tried to scoop up the corn with her hand, which picked up dirt along with the corn kernels. When the grandmother saw what the little girl was doing, she said, "Do not do it like this. You have to do it with respect." Then grandmother picked up each individual corn kernel with her fingers, and one by one, separated them from the dirt as she counted them: Jun, cheb, oxeb (one, two, three) and told the girl, "You must do it with respect. You must touch the corn with respect." She continued counting: chaneb, joeb, wakeb, etc.. (four, five, six, etc.)

When the grandmother told her granddaughter that corn is treated with respect, she was giving value to the meaning they give to corn: "It is our food. We made it and live it, so it must be looked after, treated with respect as our parents taught us." The *Popol Vuh*, the sacred book of the Mayan people, says that men are made of corn, written in 1558, Published by Carl Scherzer in 1857 (Brunhouse en 1973:126–127). Each kernel of corn is treated as unique: when she counted, she was giving each kernel of corn its place. We can see that various dimensions converge on the fact of collecting and counting the corn kernels. There is a cognitive dimension in the consecutive assigning to each corn kernel the name of each number of the ancient Mayan language, but this is not the only dimension present: there is also an attitude of respect shown in the body's movement to separate with such care each grain of corn from the dirt. This action is characterized by the grandmother as treating the corn "with respect".

The conviction that everything lives and has a heart is typical of the Mayan cosmovision. In fact, corn has a heart, because there is nothing in the world that does not have the heart that corresponds to the beginning of life, the soul (Lenkersdorf, 2004: 51). We find ourselves in a cosmos that has a heart and lives. Therefore, it demands that we learn to respect it, to live with the cosmos itself and to open our perspective to realize that life is broader than anything that our eyes make us believe and accept (Lenkersdorf, 2004: 54).

Counting is common in everyday activities using the body as a reference. The number twenty has a name that refers to one complete man.

Because our earlier ancestors with their customs could not count in Spanish the natural numbers, as previously, they had no school to learn, they are already accustomed to speak Tseltal but thought of themselves in their hearts and began to count the numbers: jun, cheb , oxeb, chaneb, jo'eb, on their hands but in Tseltal. Furthermore, not only on their hands but they also began to use their toes, so I began to tell: bulucheb, lajchayeb, oxlajuneb, chanlajuneb, jolajuneb up to the number "20" which is "a man," or Jun winik in Tseltal. This is why we Mayans began to count the numbers in this way. (Mariano, tseltal, 75 years old).

In the second case, the numbers one to thirteen have a reference to the Mayan gods that shows the relation between the name and one specific god who takes care of some aspect of life.

The numbers and the Gods

When the Mayan people use numbers, they recall a god. This affirmation we can illustrate with the planting of corn. When Mayan people plant corn, they perform rituals to ask for help from the gods and ancestors, who somehow share the same status as the gods (Lopez Austin y Millones, 2008). These rituals are performed on specific dates that have to do both with the name of the numbers, and with the god that "owns" the number. The ritual for help in planting corn is performed on the 8th day of the month before planting, since the number eight corresponds to the Mayan maize god.

Looking at the name of the number 8 and the glyph that corresponds to it, we find that the name means ear of corn (waxakeb) and glyph has a god-profile drawn with an ear of corn on its ear (Barriga, 2004). Therefore, the rituals to ask for good planting and harvesting of corn are performed on day 8, as mentioned above. There is a very close link between the cognitive dimension that establishes quantitative relations and dimensions that have to do with the naming of the number and with spiritual connotations.

Numbers have been involved in the social practices of Mayan people, such as the planting of corn, as we saw in the last paragraph. The social practice of embroidery is another place where numbers have been utilized. There are cosmovision references inside each social practice in order to use numbers in everyday life, and these numbers have cultural meanings. The historical-cultural approach used in this study allows us to identify the situations in which numbers are involved, and to understand the specific meanings they have in the life of the Mayan people.

Table 1

The name of number and gods.

Decimal Digit	Vigesimal Digit (current use)	Gods (Barriga, 2004)	Linguistic roots (Mayan)
1	jun	Goddess of the moon	jun
2	cheb	The maiden of the twin god	cha'
3	oxeb	The god of the wind	ux
4	chaneb	The god of the sun	chin
5	joeb	The god of the underworld	ho'
6	wakeb	The god of decapitation	wik
7	jukeb	The jaguar god of the underworld	huk
8	**waxakeb**	**The god of maize**	**waxik**
9	baluneb	The twin hero	bolon
10	lajuneb	The god of death	lijun
11	lajxayeb	The god of the Earth	buluch
12	bulucheb	The god of the Star	lajchin
13	oxlajuneb	The Feathered Serpent	ux-lijun

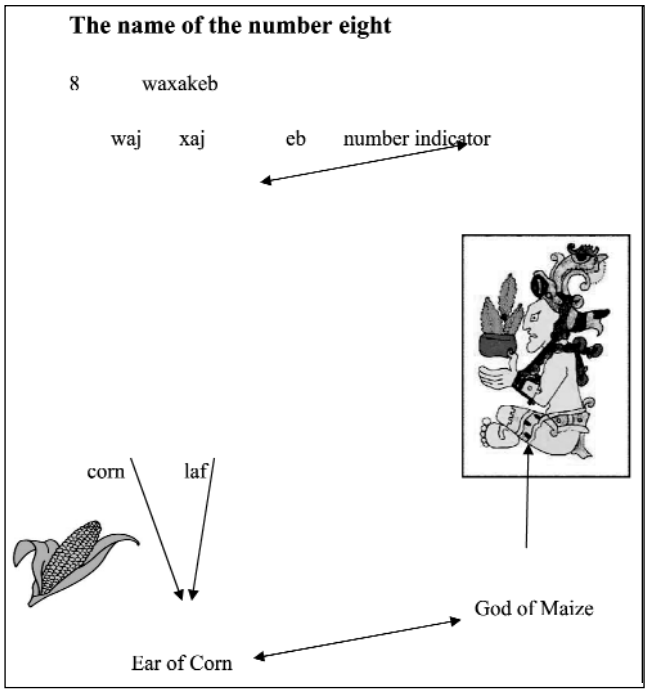

Figure 1. The name of the number eight

The heart. The center of reason, wisdom, life itself

In the Mesoamerican cosmovision the concept of the heart is particularly important because the heart is considered the center of the human being and the center of the community. Thus, the heart is the receptor of the divine essence, which is deposited by the projection movement when things were created and when the human being was born. Therefore, the Mayan people have a strong conviction about the world: everything lives and everything has a heart (Lenkersdorf, 2004: Lopez Austin, 2005).

We, the humans, live in a cosmos that is alive. There is no such thing as dead nature. Humans live in a cosmos where there is no dead nature. We are one species among others, and therefore, we should be humble and not arrogant as if the world and nature were at our disposal (Lenkersdorf, 2004; pp. 20).

Lenkersdorf's observation addresses the concept of heart. In his studies with Mayan Tojolabal people, we can understand that everything has a heart. The heart contains the concept of life, referring not only to physical life, but life in its entirety. The heart is the principle of life.

This aspect can be seen in the way of naming those who die: they are named with a word that has its roots in the word heart-- in Tojolabal altzil-- to which the suffix "al" is added-- altzilal. The suffix "al" is generalized and depersonalized, so it is considered that all who die are part of a group called altzilal who keep their heart. Therefore, for the Mayan people, death is a reality annihilating the human being; by contrast, the concept of altzilal emphasizes the absence of a final death. As Lenkersdorf wrote: "The dead are thus living hearts in general. We are in a cosmos that has a heart and lives" (Lenkersdorf, 2004; pp. 23).

When someone dies, it is said that "he lost his heart" to name the body. For example, when the body is dead, the word "altzilal" is used instead of heart, "altzil." Altzilal retains an idea and a reality that is not present in the body. "The heart (altzil in Tojolabal) represents the life principle or soul that gives life to men, animals, plants and all things that dwell on Earth, because there is nothing that has no heart, has no life" (Lenkersdorf, 2004; pp.22).

The heart is the repository of all the action of a human being on earth, so the main activities are carried out with this part of one's being. Knowledge in particular is associated with the heart, so that the mind is considered "the head of the heart." Or, when we speak of knowledge it is said that knowledge "makes you reach your heart."

The heart holds all wisdom; it is the seat of memory and knowledge; through it perception takes place. Emotions are an aid to mental processes, as well as body functions. It is said that what is heard with pleasure or fear is not forgotten; if you want to work the heart, the body does not tire (Guiteras, 1965; pp. 65).

The Mayans do not attach much importance to reason; rather it is the heart that enables people to use their good sense and perhaps, or rather, their wisdom, and the wisdom of the heart, not the wisdom of the head (Lenkersdorf, 2004). Emotional life takes precedence over intellectual life (Guiteras, 1965). "The heart has a lot of talk: what they have seen, all they know is in the heart and goes to the head. Take good care of the heart: those who remember and know many things, it's because their heart has taken care of them" (Guiteras, 1965; pp. 75).

When it come to other activities in which the senses are involved-- either smell, taste, hearing, touch, or sight, as well as the fact of trying to eat something, the perception of taste or visio the Mayan people consider that these activities are also performed with the heart. "Taste is perceived in the nose and the tongue, throughout the mouth, but in the heart and the whole body we feel delicious" (Guiteras, 1965; pp. 81).

We find in the language of everyday life of the Mayan people many expressions that indicate the location of the heart in relation to all life on earth, because, according to Lopez Austin (2005), divinity was projected from the origin to all of the world.

Thus a man says, "Our maize is already in his heart sad because I have not gone to see it in a week." Another expression is "My heart was grieved because their hearts are very hard." When there is forgetfulness, it is said that "I lost my heart," or Tseltal groups say, "I dropped my heart".

We will see how the women embroiderers express that they made embroideries with their heart. The implications of the heart in relation to a specific activity in the Mayan community include all dimensions of human being.

Embroidering with the heart

Through an explicit description of the Mayans' daily life I will approach the use of numbers in an attempt to show the quantitative relations immersed in their social practices. I will begin by introducing some aspects of everyday life that allow us to draw closer to the elements we have identified as the most relevant aspects of the Mayan cosmovision applied to Tseltal daily life.

The most important vital concerns in Mayan communities revolve around agriculture. They basically sow corn and coffee to cover their needs, and, to a lesser degree, some families in the community plant beans, squash, chayotes and bananas. The way they plant and harvest these crops, especially corn and coffee, determines how they organize their daily lives. They use the rest of their time for other activities once they have ensured that they will be able to harvest their corn crop. For example, women embroider their blouses and sometimes sell their work outside the community, while men clean the house or build new rooms, get together to visit during the afternoon, while the children play.

An example that shows the relation between how numbers are used and the Mesoamerican cosmovision can be found in the practice of women's embroidery. The relations of quantity and the way numbers are used by the women as they embroider take place in an activity that includes various personal dimensions of the person doing the embroidery: body, cognition, emotions, and aesthetic sense of beauty. An embroiderer says she embroiders "with her heart."

Miriam: How did you make that blouse?

Maria: I made it with my heart.

Mi: And how is it that you make it with your heart?

Ma: Here I put the pink (points to the embroidery she is doing) and then the red. I went on counting until the flower was there and then I counted others to the half to make the leaf. I went looking (seeing) to put the colors well on all the flowers, so not too much, not too little.

Mi: And how do you do it so that there's not too much, not too little

Ma: Here (pointing to the row of pink cross stitches) I took out one, and here (pointing to the red cross stitches) I put in another two because they were missing.

Mi: And when do you finish embroidering it?

Ma: When it's already pretty.

In this dialogue various dimensions appear: cognition when she executes operations ("I took out one... I put in another two"), the body when she introduces the thread to make each cross stitch, a sense of beauty ("When it's already pretty") and the emotion she expresses at that moment, happiness and satisfaction that can be perceived in her tone of voice. These dimensions are considered within the action "to make with the heart." But, what does it mean to say "make with the heart"? Does it only refer to emotion? Evidently not, because cognition and the body are also included. Does it refer only to these dimensions? What other implications might that phrase have?

To try to respond to these questions I read over my field work notes and found reference to "the heart" used by others in various activities, and not only by women when they embroidered. The men said it when they were finishing planting corn; young people said it when they finished a chore that implied a lot of concentration, time and work. A teacher, Gerardo, said at the end of a meeting of Mayan teachers, "Companions, remember that we all have a mission sown in our hearts, that we have to find it." The word "heart" is also used in greeting someone; instead of saying "How are you?" people say "How is your heart?" And the other answers "My heart is..." and may add: content (happy), sad, hungry, cold. To speak of the heart implies that one is speaking of the whole person, including the head, the body, feelings. When one says "to make with the heart," it appears to mean that they are carrying out an action from the very center of their person.

There are other situations in embroidery that show how the embroiderers utilize the concept "heart" in order to express how they do their work. The common aspect of these particular situations is that the women embroider one object from another which is bigger than the final embroidery. Thus, the different sizes are relevant for us because in these cases, the woman embroiderer says that she did the new smaller piece with her heart. I will present to you two cases: in one case the woman embroiders a blouse, and in the other case, the woman embroiders a small tablecloth.

M: For example, this embroidery is big, and when do you do it as a small embroidery, how do you do it?

H: I do it with my heart. I will show you.

M: She explained how she can calculate the threads to embroider the blouse. She said that she constructs with her mind the flower, the small flower, she begin to design and organize and invent. She imagines one big flower more or less, then she sees one big flower and then she imagines it smaller than the first one and she embroiders it.

H: (she shows the small blouse and says) I do this blouse with my heart.

M: This is the thing that you invent?

H: Yes.

M: This (showing the embroidery of the small blouse) design she does not copy, she doesn't copy from anywhere, she does that with her heart only.

The embroiderer explains how she does one small blouse instead one big blouse. She explains with the expression "I do it with my heart" and "I did it with my heart." In this case the numerical aspects have a relation to cosmovision concepts and plus, the numerical activity in reference to the cosmovision is done with all the human being, not just with cognition, but with the corporal, affective, intellectual, and spiritual dimensions, which are called "heart."

Another embroiderer shows us how she embroiders one small tablecloth in comparison with another big tablecloth.

M: These flowers are the same (showing one piece of cloth embroidered with flowers), we can appreciate that the designs are completely the same. How can you embroider the same flowers but in different sizes?

H: I think first. First I must do one complete flower (complete means to do one flower of the small size with all of its parts) so that all the flower can fit in, and it is here where I do that with my heart, until I embroider the flower, the leaf, it means one complete flower (she shows the cloth embroidered). So, I begin to design all parts of the flower until I finish one part and I begin the other part when I finish everything, because I do the model first, and this is the example for all the small cloth.

M: And, what does it mean to do one part?

H: It is a complete flower with its leaf too.

In both cases, it is possible to identify a particular form of mathematics. The fact of doing one piece from another implies observation, multiple mental functions, and multiple body functions. When the women compare the big design with the small one that they want to embroider, they construct the proportional relations: "She sees one big flower, then she imagines it but smaller and she embroiders it."

There are many ways to do it, but the women always see the big object, imagine the small object in order to embroider it, and then they embroider the design until they consider that the embroidery is complete. The embroiderers relate this activity to one fundamental aspect of the Mayan cosmovision: the heart, when they say the way to do one small blouse or tablecloth from another bigger one is "with the heart".

Moreover, if we look at the Mesoamerican cosmovision we find, following Lopez Austin (2005), that the seed-heart is one of its fundamental aspects and explains the fact that every human being is a projection of the divinity, given that the seed-heart was sown in each person at the moment of birth and is that which contains each person's characteristics.

So, when a Mayan man or woman refers to the heart, he or she is talking about all the dimensions of a person, not only the emotional part as understood in Western usage. They refer to the heart when they want to communicate that their whole person is involved in the action they are carrying out or have carried out. This is why when making relations of quantity, in this case, when counting, adding and subtracting or lessening, measuring and adjusting-- operations that embroiderers do when they are adorning their blouses and other articles of daily use-- they are not involved in an activity that is only cognitive and isolated from other dimensions of their person, as math activities in school tend to be conceived. Rather they are involved in a social practice that includes diverse dimensions of the person and, even more, they are renewing the tie with the divine by carrying out the social practice of embroidery.

Conclusions

Cultural aspects are present in the practice of Mayan embroidery. The political and economic consequences of this way of embroidering can be found in the fact that they are not taken into account and are even considered to be of little value in a society, such as the greater part of Mexican society, that has Western civilization as its reference point. Of course this relates to schooling, given that community-based wisdom (saberes) and the relations with their own cultural cosmovision are ignored in the curriculum and also in teachers' daily practice in Mayan communities.

This sociocultural grounding of Mayan math practices has not been taken into account in educational policy or in the application of classroom strategies. The decimal number system continues to be in use without taking into account the knowledge of math that Mayan communities possess. We feel it is important and necessary to start off with the idea that understanding the world and everyday life is much broader in scope than simply understanding a Western vision of the world (De Sousa, 2010). We must be cognizant of the fact that there are other ways of viewing the world, so that cultural knowledge can be recognized and taken into account for educational purposes (Saxe, 1988; Bishop, 1999; Nunes, 1992).

The meanings assigned to the numbers by Mayan people in their social practices are the same ones that children and young people learn when they participate in these practices. Thus, they learn to name the world in their native language with the same set of meanings transmitted by their parents and grandparents.

We are convinced that great importance must be given to the meanings of numbers among the Maya: they must be taken into account in the development of learning strategies and educational policies concerning the mathematics curriculum for their schools. For example: The Mayan people takes into account the logic of "20 by 20" supports the development of early math skills of children.

We are not suggesting that children learn only the Mayan vigesimal number system in school, but that they develop their math skills through it. It is also important to expand their mathematical knowledge through the learning of other digital systems such as the decimal with relevant strategies that aim to improve the children's academic achievement and development.

Thus mathematics, considered to be quantitative relations, is an expression of the world according to the Mayan cosmovision, which in turn provides us with the opportunity to understand the special way in which the Mayans view numbers as part of Mesoamerican civilization, which is different from the way math is seen in Western civilization.

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Использование чисел в вышивке цельталей, индейцев майя

Мириам Морамай Микалко Мендес

аспирантка факультета исследований в образовании, Центр передовых научных исследований Национального политехнического института, Мексика

В мезоамериканской цивилизации, особенно в культуре майя, числа предстают элементами картины мира, а не только инструментом для осуществления вычислений, как это происходит в западных обществах, где их функция воспринимается почти исключительно как вспомогательная при различного рода подсчетах и моделировании реальности. Изучение того, как пользуются числами в своей повседневной жизни цельтали, индейцы группы майя, позволяет рассмотреть количественные отношения сквозь призму культурно и исторически обусловленных социальных практик. В настоящей статье представлен анализ использования чисел женщинами-вышивальщицами племени майя, выявивший некоторые когнитивные и социокультурные аспекты, касающиеся, в том числе, специфических культурных смыслов, связанных с космологией майя. Особенно важными оказываются смыслы, напрямую отсылающие к сердцу и тому, что является священным. В статье показано, как через повседневное использование чисел в своей работе вышивальщицы выражают и сами участвуют в поддержании издревле существующих культурных и социальных представлений майя о мире. Схожим образом эти представления отражаются и в названиях чисел, вобравших в себя элементы общественного устройства майя, телесной организации, и даже имена богов.

Ключевые слова: культура, количественные отношения, космология, сердце.