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Three approaches in the research field of ethnomodeling: emic (local), etic (global), and dialogical (glocal)

Três abordagens no campo de pesquisa da etnomodelagem: êmica (local), ética (global) e dialógica (glocal)

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Abstract

The acquisition of both *emic* (local) and *etic* (global) knowledge is an alternative goal for the implementation of ethnomodeling research. Emic knowledge is essential for an intuitive and empathic understanding of mathematical ideas, procedures, and practices developed by the members of distinct cultural groups. It is essential for conducting effective ethnographic fieldwork. Furthermore, emic knowledge is a valuable source of inspiration for etic hypotheses. Etic knowledge is essential for cross-cultural comparisons, which are based on the components of ethnology. In this regard, such comparisons demand standard units and categories to facilitate communication. Dialogical (glocal) is a third approach for ethnomodeling research that makes use of both emic and etic knowledge traditions through processes of dialogue and interaction. Ethnomodeling is defined as the study of mathematical phenomena within a culture because it is a social construct and is culturally bound. Finally, the objective of this article is to show how we have come to use a combination of emic, etic and dialogical (glocal) approaches in our work in the area of ethnomodeling, which contributes to the acquisition of a more complete understanding of mathematical practices developed by the members of distinct cultural groups.

Keywords: Etic, Emic, Dialogical, Ethnomodeling, Ethnomathematics, Mathematization

Resumo

A aquisição de ambos os conhecimentos êmico e ético é um objetivo alternativo para a implementação da pesquisa em etnomodelagem. O conhecimento êmico é essencial para o entendimento intuitivo e empático das ideias, procedimentos e práticas matemáticas desenvolvidas pelos membros de grupos culturais distintos. Esse conhecimento também é essencial para a condução de trabalho de campo etnográfico. Além disso, o conhecimento êmico é uma fonte valiosa de inspiração para hipóteses éticas. O conhecimento ético é essencial para a comparação entre as culturas, que é baseada nos componentes da etnologia. Nesse sentido, essas comparações demandam unidades e categorias padronizadas para facilitar a comunicação. A dialógica (glocal) é a terceira abordagem para a pesquisa em etnomodelagem que utiliza as tradições e os conhecimentos êmico e ético por meio de processos de diálogo em interação. A etnomodelagem é definida como o estudo de fenômenos matemáticos dentro de uma cultura porque é um construto social e culturalmente enraizado. Finalmente, o objetivo desse artigo é mostrar como utilizamos a combinação das abordagens êmica, ética e dialógica (glocal) em nosso trabalho na área de modelagem, que contribui para a aquisição de um entendimento mais completo das ideias, noções, procedimentos e práticas matemáticas desenvolvidas pelos membros de grupos culturais distintos.

Palavras-chave: Ética, Êmica, Dialógica, Etnomodelagem, Etnomatemática, Matematização.

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INTRODUCTION

In this paper, we would like to share how we have come to use a combination of emic[3] (local), etic (global) and dialogical (glocal) approaches in our work in the area of ethnomodeling. When investigating forms of knowledge possessed by the members of distinct cultural groups, we easily find unique and interesting mathematical ideas, characteristics, procedures, and practices that are different forms of ethnomathematics. This information can be used to both express and explore the relationships between culture and mathematics.

Any outsider's (etic) understanding of cultural traits[4] is based on the many unique interactions and interpretations that emphasize inessential features as well as the misinterpretation of distinctly unique and culturally mathematical forms of knowledge. The challenge that arises from this understanding is how culturally bound mathematical ideas are better understood without letting the culture of both researchers and investigators interfere with the culture of the members of the cultural group under study. This is not easy and may only happen when the members of cultural group under study share the same interpretation of their culture (emic) as opposed to an outsider's interpretation (etic).

On the other hand, any insider's (emic) view of cultural traits are based on factors such as cultural and linguistic backgrounds, social, moral values, and lifestyle that directly influence mathematical ideas, procedures, and practices developed by the people of their own culture and context. Over time, different cultural groups have shared, developed and evolved different ways of doing mathematics in order to understand and comprehend their own cultural, social, political, economic, and natural environments (Rosa, 2010). Each

[3]The concepts of emic and etic were first introduced by the linguist Pike (1954) who drew upon an analogy with two linguistic terms. Phon***emic***, which are the sounds used in a particular language and phon***etic***, which are related to general aspects of vocal sounds and the actual sound produced in language. In other words, all the possible sounds human beings can make constitute the phonetics of language. However, when people actually speak a particular language, they do not hear all its possible sounds. In this regard, as modeled by linguists, not all sounds make a difference because they are locally significant, or they are the phonemics of that language.

[4]Cultural traits is a system of knowledge that consists of patterns of traditions, meanings, beliefs, values, actions, experiences, attitudes, hierarchies, religion, notions of time, norms, roles, spatial relations, concepts of the universe, artifacts, mentifacts, sociofacts, and symbols acquired by a group of people, which are passed on from one generation to the next and are shared to varying degrees by interacting members of distinct cultural groups (Ting-Toomey & Chung, 2005; Samovar, Porter, & Stefani, 1998).

cultural group has developed many unique and often distinct ways to *mathematize* their own realities (D'Ambrosio, 1990).

In this context, mathematization is the process in which members of distinct cultural groups come up with different mathematical tools that help us to organize, analyze, solve, and model specific problems located in the context of our own real-life contexts and situations (Rosa & Orey, 2006). These tools allow them to identify and describe specific mathematical ideas, procedures, or practices by schematizing, formulating, and visualizing problems in different ways, discovering relations and regularities, and transferring real world problems to academic mathematics through the process of mathematization.

As increasingly diverse elements engage with each other, it is important to search for alternative methodological approaches in order to record mathematical ideas, procedures, and practices that occur in different cultural contexts. One alternative methodological approach to this is *ethnomodeling*, which we consider the practical application of ethnomathematics (Rosa & Orey, 2010). This need for a culturally bound form of mathematical modeling is rooted in the theory of ethnomathematics (D'Ambrosio, 1990).

ETHNOMATHEMATICS

Our work incorporates the term *ethno,* which describes characteristics related of a group's cultural identity such as language, codes, values, jargon, beliefs, food and dress, habits, and physical traits. To us the term *ethnomathematics* expresses a broader view of mathematics and includes diverse forms ciphering, arithmetic, classifying, ordering, inferring, modeling, and the ability to communicate and dialogue about it (D'Ambrosio, 2001).

We describe ethnomathematics as the arts and techniques (*tics*) developed by members from diverse cultural and linguistic backgrounds (*ethno*) to explain, to understand, and to cope with their own social, cultural, environmental, political, and economic environments (*mathema*). *Ethno* refers to distinct groups identified by cultural traditions, codes, symbols, myths, and specific ways of reasoning and inferring. Detailed studies of mathematical procedures and practices of the members of distinct cultural groups most certainly allow us to further our understanding of their internal logic and mathematical ideas (D'Ambrosio, 1990).

According to this context, ethnomathematics is a theoretical concept that is broader than traditional or academic mathematics, ethnicity or the many ideas found in multiculturalism. It is the intersection of cultural anthropology, mathematics, and mathematical modeling, which is used to help us to both understand and connect diverse mathematical ideas and practices found in our communities to traditional and academic mathematics (Rosa, 2000). Figure 1 shows how ethnomathematics is an intersection of these three research fields.

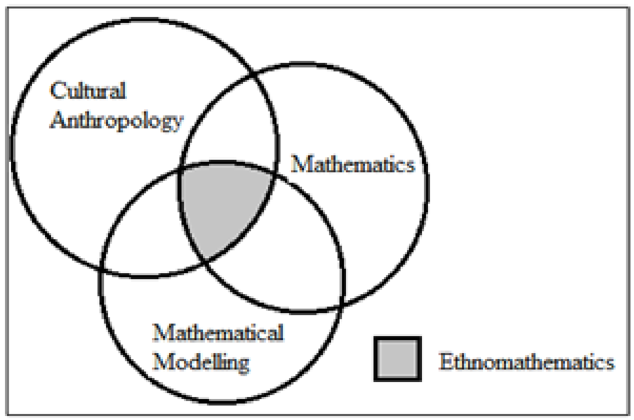

Figure 1. Ethnomathematics as an intersection of three research field.
Source: Rosa (2000)

Ethnomathematics is a program of study that allows for the understanding, comprehension, articulation, processing, and ultimately the use of mathematical ideas, procedures, and practices that enable us to solve problems related to our daily activities. This helps students reflect, understand, and comprehend the relations among components of systems under study (Rosa, 2000).

ETHNOMODELING

Ethnomodeling as the study of mathematical ideas and procedures elaborated by members of distinct cultural groups and involves the study of the mathematical practices developed, used, practiced, and presented in diverse situations in the daily life of the members of these groups (Rosa & Orey, 2010). This allows those engaged in this process to study mathematics as a system relative to their own contextual reality in which there is an equal effort to create an understanding of all components of these systems as well as the interrelationship among them (D'Ambrosio, 1993; Rosa & Orey, 2003).

According to this context, ethnomodeling is the intersection of cultural anthropology, ethnomathematics, and mathematical modeling. Which we consider as a "tool towards pedagogical action of an ethnomathematics program, students have been shown to learn how to find and work with authentic situations and real-life problems" (Rosa & Orey, 2010, p. 60). Figure 2 shows ethnomodeling as an intersection of three research fields.

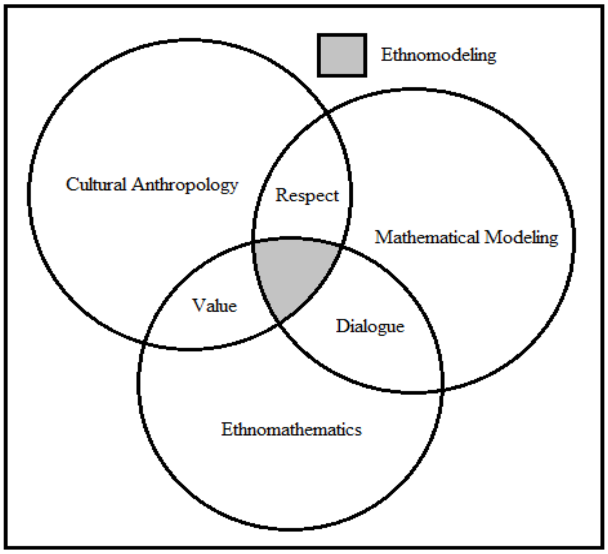

Figure 2. Ethnomodeling as an intersection of three research fields
Source: Rosa e Orey (2010)

Researchers, investigators, and educators such as Ascher (2002), Eglash (1999), Orey (2000), and Rosa & Orey (2009) have revealed a diversity of elegant and sophisticated mathematical practices that include the geometric principles in craft work, architectural concepts, and practices in the activities and artifacts of many indigenous and local cultures (Eglash, Bennett; O'Donnell; Jennings; and Cintorino, 2006). Many of these concepts are related to the numerically based relations found in measuring, calculating, playing games, divining, navigating and astronomy, modeling, and a wide variety of other mathematical procedures and artifacts (Eglash et al., 2006).

We have come to use the term *translation* to describe the process of modeling local cultural systems (*emic*) and which may have global Western-academic representations (*etic*)

(Eglash et al., 2006; Rosa & Orey, 2006). An effective use of ethnomathematics makes use of modeling in order to establish relations between local conceptual frameworks (emic) and the mathematics embedded in relation to local designs. More often than not local designs have been both analyzed and interpreted from a Western view (etic). One example of this practice might include the applications found in the symmetry and classifications in crystallography to indigenous textile patterns. In some cases, “the translation [of mathematical procedures and practices] to Western mathematics is direct and simple such as found in counting systems and calendars” (Eglash et al., 2006, p. 347).

However, there are cases in which mathematical ideas and concepts are “embedded in a process such as in iterations found in bead work, or in the Eulerian paths in sand drawings” (Eglash et al, 2006, p. 348). Therefore, it is that this act of translation as applied in this process is best referred to as ethnomodeling where mathematical “knowledge can be seen as arising from emic rather than etic origins” (Eglash et al, 2006, p. 349).

An emphasis of ethnomodeling takes into consideration processes found in the construction and development of mathematical knowledge and can include unique aspects as well as patterns of collection, creativity, and invention. It has become impossible for us to imprison mathematical concepts in one form of reality because, as we are seeing when many of our communities interact in a globalized context, distinct systems provide unambiguous representations of reality (Craig, 1998).

According to this context, its principles, concepts, and foundations are not always the same everywhere; mathematics may no longer be conceived entirely as a universal language (Rosa, 2010). It may be a language, but one that has a variety of accents and diverse forms of vocabulary, unique to the culture it is used in. The choice among equivalent systems of representation can be founded on considerations of modeling simplicity, and for no other consideration than simplicity, can justly “adjudicate between equivalent systems that univocally designate reality” (Craig, 1998, p. 540). The dynamic processes found in the production of a diversity of mathematical ideas, procedures, and practices operate in the register of interpretative singularities that regard possibilities for a symbolic construction of knowledge in different cultural groups (Rosa & Orey, 2006).

THE EMIC AND ETIC CONSTRUCTS OF ETHNOMODELING

In using an ethnomodeling approach, many emic constructs are the accounts, descriptions, and analyses expressed in terms of the conceptual schemes and categories regarded as meaningful and appropriate by the members of the cultural group under study (Lett, 1996). This means that an emic construct is in accordance with the perceptions and understandings deemed appropriate by the insider's culture. The validation of emic knowledge comes through consensus, which is the consensus of local people who must agree that these constructs match the shared perceptions that portray the characteristic of their culture (Lett, 1996).

Most emic approaches investigate mathematical phenomena and their interrelationships and structures through the eyes of people in a particular cultural group. It is important to note here that the particular research technique used in acquiring emic mathematical knowledge has nothing to do with the nature of that knowledge. In this regard, the "emic mathematical knowledge may be obtained because it is possible that objective observers may infer local perceptions" (Lett, 1996, p. 382) about mathematical ideas, procedures, and practices.

It is necessary to state that etic constructs are considered accounts, descriptions, and analyses of mathematical ideas, concepts, procedures, and practices expressed in terms of conceptual schemes and categories regarded as meaningful and appropriate by the community of scientific observers, researchers, and investigators (Lett, 1996). An etic construct is precise, logical, comprehensive, replicable, and includes an independent observer-researcher element. In so doing, the validation of etic knowledge becomes a matter of logical and empirical analysis, where the logical analysis of the construct meets the standards of comprehensiveness and logical consistency. The empirical analysis of whether or not mathematical concepts have been replicated (Lett, 1996) is then evident.

It is important to emphasize here that particular research techniques used in the acquisition of etic mathematical knowledge may have little bearing on the nature of that knowledge. Etic knowledge may be obtained at times through questioning as well as observation, because it is entirely possible that informants possess scientifically valid knowledge (Lett, 1996). Researchers and investigators must come to acknowledge and recognize that local people possess both scientifically and mathematically valid knowledge (D'Ambrosio, 1990).

MATHEMATICAL PHENOMENA AND THEIR ETHNOMODELS

Many researchers and investigators have made extensive use of mathematical procedures ranging from statistical methods for the interpretation of patterns in behavior to mathematical representations in the processes of local conceptual and logical systems. Mathematical modeling has been considered as a pedagogical tool and by others as a way to understand anthropological and archaeological perspectives of mathematics. Yet, others have decried the use of the mathematical, and in particular, statistical and quantitative modeling as fundamentally in opposition to a humanistic approach to understanding human behavior and the knowledge that takes into account the contingency and historical *embeddedness* which in turn, decries universality. Traditional mathematical modeling practices have not fully taken into account widespread implications of diverse aspects of human social behavior.

It seems to us that this cultural component is critical, and emphasizes "the unity of culture, viewing culture as a coherent whole, a bundle of [mathematical] practices and values" (Pollak & Watkins, 1993, p. 490) that often appears incompatible with the rationality and the elaboration of traditional mathematical modeling process. However, in the context of mathematical forms of knowledge, what is meant by the *cultural component* varies widely and ranges from viewing mathematical practices as learned and transmitted to and from members of diverse groups to mathematical practices viewed as abstract symbolic systems with a deep internal history and logic that provides a symbolic system to its mathematical structure.

If the former is considered, then it is the process by which knowledge transmission takes place from one person to another, which is central to elucidating the role of culture in the development of mathematical knowledge (D'Ambrosio, 1993). If the latter is considered, then culture plays an important role in the constructive role with respect to mathematical practices that we cannot induce through observation and study (Eglash et al, 2006).

Mathematical knowledge developed by members of a specific cultural group consists of abstract symbol systems and is the consequence of historical-cultural events and unique internal logic, where people have developed, accumulated, diffused, and learned instances and definite usages of symbol systems. What is derived from these instances forms a cognitively-based understanding of the internal logic of unique mathematical symbolic systems. Cognitive aspects needed in this framework become primary decision-making processes by which members either accept or reject an ethnomodel as part of their own repertoire of mathematical knowledge. The conjunction of these two scenarios appears to be adequate to the depth needed to encompass a full range of cultural mathematical phenomena.

There are two ways in which we learned how to recognize, represent, and make sense of the diverse mathematical phenomena we encounter. First, there appears to be a level of cognition that we all share, to varying degrees, with the members of our own and other cultural groups. One can say this is part of the overall human cognitive endowment. This level includes cognitive models that we elaborate on at a non-conscious level, which serves to provide an internal organization of external mathematical phenomena in order to provide the basis upon which diverse mathematical practices take place. Second, there are a number of culturally constructed representations of external mathematical phenomena that provide us with a sense of an internal organization.

However, this representation arises through the formulation of abstract and conceptual structures that forms a sense of organization for external phenomena we encounter. Cultural constructs provide us with representations for systems taken from reality. The implications for this form of mathematical modeling are that these models engage cultural constructs and are considered symbolic systems organized by an internal logic of the cultural group members themselves. Models built without a first-hand sense for the world being modeled should be viewed with suspicion (Eglash et al, 2006; Rosa & Orey, 2010).

Researchers and investigators, if not blinded by their own cultural backgrounds are profoundly influenced by the paradigm in which they are immersed, which includes all prior theory and ideology that they have absorbed. If they are aware of this they should come out with an informed sense of distinction that makes a difference from the point of view of the mathematical knowledge of the work being modeled. In so doing, in the end, they will be able to tell outsiders (etic, glocal) what matters to insiders (emic, local).

The Ethnomodel of the Gable Roof

An informant from a roofing contractor cultural group can easily describe the practices acquired for the construction of a roof gable, which is the most commonly used type of pitched roof construction. After choosing the type of tile such as red roofing tiles or shingles on the tiled roofs to begin the construction of the roof, it is necessary that roofing contractors calculate the slopes of the wooden beams that form the triangles in the gable. Gabled roofs often possess a ridge near or at the center and slopes in two directions. It is simple and common in design, economical to construct, and can be used on any type of structure, and in any type of climate.

Roofing contractors use triangles because they are stable, rigid and have no mobility. In this context, the main objective of the roofs is to provide quick protection from climate because they must be strong enough to withstand high winds, and shed moisture and often snow and ice quickly. Roof slope and rigidness are for shedding water and any excess weight provided by snow and ice, and bearing any extra additional weight.

In the case of many roofs in Brazil, roofers calculate the slope of the roof by applying a ratio between the height and the length of the gable, which is expressed as a percentage. For example, the percentage of the slope (trim) for the roof to the tiles is at least 30% so that rainwater can quickly drain. According to this approach, for each meter (100 cm) that runs horizontally, there is a vertical rise of 30 cm. Thus, if the length of the gable is $L = 8$ meters, roofing contractors mentally perform the percentage calculation by using $a = 4$ meters, which is half of that measure. Then, they multiply it by the percentage of the slope of the roof. For example, 30% of 4 meters corresponds to the height of 1.20 m. Figure 3 shows the scheme of a gable used in roof constructions.

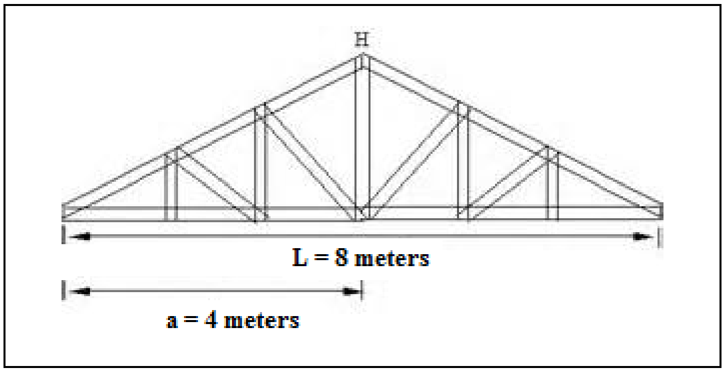

Figure 3. Scheme of a gable used in roof constructions

Conversely, researchers and investigators can describe this mathematical practice (emic, local) by using the Pythagorean Theorem (etic, local). However, it is important to understand the dialogical (glocal) relationship between these two approaches. For example, the informal calculation (emic knowledge) of the height (trim, flow) of the gable does not preclude the use of the Pythagorean Theorem (etic knowledge) by these professionals. In other words, these professionals strive to compare, interpret and explain this mathematical knowledge they observe and that the members of this cultural group are experiencing.

Some Considerations about the Ethnomodeling of the Gable Roof

An emic observation of this mathematical practice sought to understand it for building how Brazilians build gabled roofs from the perspective of internal dynamics and relationships as influenced within the culture of roofers. On the other hand, an etic perspective provides a cross-cultural contrasts and comparative perspectives by using aspects of academic mathematics that translate this practice in order to create a new understanding of those from a different cultural background. This approach is necessary to comprehend and explain this particular mathematical practice as a whole from the point of view from that from the outside.

From this context, the emic viewpoint clarifies intrinsic cultural distinctions while the etic perspective seeks objectivity as an outside observer across cultures. This is the dialectical approach, which concerns the stability of relationships between these two often different cultural approaches. In our point of view both perspectives are essential to understanding human behaviors (Pike, 1996), especially, social and cultural behaviors that help to shape mathematical ideas, procedures, and practices developed by the members of distinct cultural groups and how they apply practical approaches and use mathematics.

Finally, there is a need to integrate the teaching of this science with other interdisciplinary knowledge areas at all levels of education. In order for this process to be successful as well as for the mathematics to be valued, the contents that we consider unique and valuable is the use Ethnomodeling in order to link the theory into practice, and include a dialogical approach.

THE DIALOGICAL (GLOCAL) APPROACH IN ETHNOMODELING RESEARCH

If we come to make any analogies regarding to ethnomodeling, it may be possible to state that emic perspectives are concerned with the differences that make mathematical practices unique from the *insider's* viewpoint. We argue that emic ethnomodels are grounded in what matters in the mathematical world of those being modeled. On the other hand, many ethnomodels are etic in the sense that they are built on data gleaned from the outsider's view that is being modeled. Therefore, etic ethnomodels therefore represent how the modeler thinks the world works through systems taken from reality while emic ethnomodels represent how people live in such worlds think these systems work in their own reality.

It is important to emphasize how etic perspectives play an important role in ethnomodeling research, yet at the same time emic perspectives should be taken into consideration in this process. Emic ethnomodels sharpen questions related to what an agent-based model should include in serving practical goals in modeling. Thus, etic mathematical ideas and procedures can be compared across cultures using common definitions and metrics while the focus of the analysis of these aspects are emic if the mathematical ideas, concepts, procedures, and practices are unique to a subset of cultures that are rooted in diverse ways in which etic activities are carried out in a specific cultural setting.

The debate between the emic-etic dynamism is one of the most intriguing questions in ethnomathematics and mathematical modeling research. Researchers and investigators continue to deal with two major questions:

1. Are there mathematical patterns that are identifiable and/or similar across cultures?

2. Is it better to focus on these patterns particularly arising from the culture under investigation?

While emic and etic are often thought of as creating a conflicting dichotomy, they were originally conceptualized as two complementary viewpoints (Pike, 1954). In this regard, rather than posing a dilemma, the use of both approaches actually deepens our understanding of important issues in scientific research and investigations (Berry, 1999). A suggestion for dealing with this dilemma is to use a combined emic-etic approach, rather than simply applying emic or etic dimensions to study or examine mathematical procedures and practices employed by members of distinct cultural groups.

A combined emic-etic approach requires researchers to attain the emic knowledge developed by members of cultural groups under study. This encourages researchers to put aside any perceived or unperceived cultural biases so that they may be able to become familiar with the cultural differences that are relevant to the members of these groups (Berry, 1990). Usually, in ethnomodeling research, an emic analysis focuses on a single culture and employs descriptive and qualitative methods to study a mathematical idea, concept, procedure, or practice of interest. Its focus becomes the study within a cultural context in which a researcher examines internal characteristics or the logic found in the cultural system itself. In this perspective, meaning is gained relative to the context and therefore not easily, transferable to other contextual settings.

The primary goal of an emic approach is a descriptive idiographic orientation of mathematical phenomena because it puts an emphasis on the uniqueness of each mathematical idea, procedure, or practice developed by the members of diverse cultural groups. Thus, if researchers and educators wish to highlight meanings of these generalizations in local or emic ways, then they will need to refer to precisely specified mathematical events. In contrast, an etic analysis is comparative, and examines cultural practices by using standardized methods (Lett, 1996). The etic approach tries to identify lawful relationships and causal explanations valid across different cultures. Thus, if researchers and educators wish to make statements about universal or etic aspects of mathematical knowledge, these statements need to be phrased in abstract ways.

On the other hand, an etic approach may actually be a way of examining the emics of the members of cultural groups because it may be useful for discovering and elucidating emic systems (Pike, 1954). In so doing, while traditional concepts of emic and etic aspects are important points of view for the understanding and comprehending cultural influences on mathematical modeling, we propose a different view of ethnomathematics and modeling which is *dialogical* in its approach (Martin & Nakayama, 2007). In this approach, the etic perspective claims that the knowledge of any given cultural group will have no real priority over the emic.

It is necessary then that we make use of "acts of translation between emic and etic perspectives" (Eglash et al, 2006, p. 347). In other words, cultural specificity may be better understood with the background of communality and the universality of theories and methods and vice versa. It is important to analyze the insights that have been acquired through subjective and culturally contextualized methods. The rationale behind any emic-etic dilemma is found in the dialogue and argument that mathematical phenomena possess in their full complexity and can only be understood within any context of culture.

FINAL CONSIDERATIONS

Today, numerous and often very diverse mathematical knowledge systems and their traditions are at risk of becoming extinct because of rapidly changing natural and socio-cultural environments fueled by the many fast pacing economic, social, environmental, political, and cultural changes occurring on a global scale. Many ancient and local mathematical practices have disappeared because of the intrusion or imposition of "foreign" etic knowledge value systems and technologies that came to from the development of concepts that promise short-term gains or solutions to problems faced by cultural groups without considering diverse emic knowledge, values or contexts that solve these very same problems. Not unlike the loss of global tropical rainforests, the tragedy of the impending disappearance of indigenous and local knowledge is equally obvious when a diversity of skills, technologies, and cultural artifacts, problem solving strategies and techniques, and expertise are lost to all of us before being archived, understood and/or saved.

Defined in this manner, the usefulness of both emic and etic distinctions are evident. Like all human beings, researchers, educators, and teachers have been enculturated to some particular cultural worldview. Therefore, we all need a means of distinguishing between answers that we derive as enculturated members of "my" group and the answers that we derive as observers of "our" group. Culture is a lens, shaping reality; it can be considered a blueprint, specifying a plan of action, by utilizing the research provided by both approaches, we gain a more complete understanding of the cultural groups of interest for all of us.

On the other hand, mathematical ideas, notions, and practices used outside of the school may be considered as a modeling process rather than a mere set of techniques to manipulate numbers and procedures. The application of ethnomathematical techniques and the tools of modelling allow us to see a different reality and give us insight into mathematics done in a holistic manner. The pedagogical approach that connects the cultural aspects of mathematics with its academic aspects is named ethnomodeling, a process of translation and elaboration of problems and questions taken from systems that are part of any given cultural group.

In conclusion, the emic, etic, and dialogical elements of an ethnomodeling research are essential in the process of designing pedagogical tools that are integrative, participative, relevant, and use of self or community as an object of learning. This approach is developed through the elaboration of activities based on the ideas, notions, procedures, and mathematical practices developed by the members of distinct cultural groups.

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