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## Artigo

### Ethnomathematics as a Methodological Perspective in Virtual Learning Environment for Teacher Training Programs

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#### ABSTRACT

The proposition for Ethnomathematics as part of an ongoing training for future teachers is in line with current trends in mathematics education. Prospective teachers can foster skills to investigate mathematical ideas and practices that occur outside the school in order to develop them pedagogically through contextualized activities, matured under an Ethnomathematics perspective. However, most teachers do not apply Ethnomathematics because, in most cases, they do not have the adequate training that allows for its implementation along with the school curriculum. It is important that pedagogical work in distance-learning environments under an Ethnomathematical perspective relates to the reality of regional centers. This will allow the use of contextualized situations and the referral to the cultural background of prospective teachers. Thus, the investigation of local mathematics practices, is an essential aspect to be introduced in Teacher Training Programs for distance learning models, if

an Ethnomathematical perspective is to be considered. The main objective of this study is to present a number of viable ways to implement the Ethnomathematics perspective in teaching practices developed in distance teaching and learning contexts. It presents a methodological approach related to that goal.

**Keywords:** ethnomathematics, distance Learning; distance learning environments; teacher training; methodological procedures; information and communication technologies.

#### RESUMEN

La propuesta de la etnomatemática para la formación inicial y continua de los futuros profesores de matemática está en sintonía con las tendencias actuales de la Educación Matemática. Estos profesores pueden desarrollar habilidades específicas para investigar las ideas y las prácticas matemáticas, que ocurren fuera del contexto escolar para exponerlas pedagógicamente por medio de actividades

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contextualizadas desvendadas em la perspectiva etnomatemática. Sin embargo, la mayoría de los profesores no utiliza esta visión, pues, normalmente no poseen una formación adecuada para implantar esa tendencia en el currículo escolar. Es importante que el trabajo pedagógico con la perspectiva etnomatemática, en el ambiente de aprendizaje a distancia, esté relacionado con la realidad de los polos visando a la utilización de situaciones contextualizadas que tengan relación con el historial cultural de los futuros profesores. Existe la necesidad de insertar en los cursos de formación de profesores de matemática, en la modalidad a distancia, la investigación de las prácticas matemáticas locales (polos) en la perspectiva etnomatemática. El principal objetivo de este artículo es presentar algunos caminos viables para la aplicación de esta visión en las prácticas pedagógicas desarrolladas en la enseñanza y aprendizaje en la modalidad a distancia. Así, la intención del artículo es la presentación de un abordaje metodológico basado en la perspectiva etnomatemática para la formación de profesores de matemática para la modalidad de enseñanza y aprendizaje a distancia.

**Palabras-clave:** etnomatemática enseñanza a distancia (EaD); ambiente de aprendizaje a distancia; formación de profesores; procedimiento metodológico; tecnologías.

## RESUMO

A proposta da etnomatemática para a formação inicial e continuada dos futuros professores de matemática está em sintonia com as tendências atuais da Educação Matemática. Esses professores podem desenvolver habilidades específicas para investigarem as ideias e as

práticas matemáticas, que ocorrem fora do contexto escolar para desenvolvê-las pedagogicamente por meio de atividades contextualizadas desenvolvidas na perspectiva etnomatemática. Porém, a maioria dos professores não utiliza essa perspectiva, pois, na maioria das vezes, não possuem uma formação adequada para implantar essa tendência no currículo escolar. É importante que o trabalho pedagógico com a perspectiva etnomatemática, no ambiente de aprendizagem a distância, esteja relacionado com a realidade dos polos visando à utilização de situações contextualizadas que tenham relação com o background cultural dos futuros professores. Existe a necessidade de inserir nos cursos de formação de professores de matemática, na modalidade à distância, a investigação das práticas matemáticas locais (polos) na perspectiva etnomatemática. O principal objetivo desse artigo é apresentar alguns caminhos viáveis para a aplicação dessa perspectiva nas práticas pedagógicas desenvolvidas no ensino e aprendizagem na modalidade à distância. Assim, a intenção desse artigo é a apresentação de uma abordagem metodológica baseada na perspectiva etnomatemática para a formação de professores de matemática para a modalidade de ensino e aprendizagem a distância.

**Palavras-chave:** etnomatemática ensino à distância (EaD); ambiente de aprendizagem a distância; formação de professores, procedimento metodológico; tecnologias.

## INTRODUCTION

Modern society uses several technological resources to solve daily and trivial problems. Demand for such resources requires Mathematics instructors to develop teaching competences and skills that allow

them to deal with the reality in which the community is inserted. In that context, it is necessary to teach distance-learning pupils of teacher training programs, mathematics content that allows them to access universal technology. Integration of new information and communication technology to the teaching and learning of Mathematics provide new options for cognitive and social engagement of these prospective teachers, preparing them for the technological innovations to come and the pedagogical consequences they might bring. Faced with that perspective, these programs offer opportunities for prospective teachers to receive vocational training that allows for the integration between information and communication technology and their pedagogical work, as technology is increasingly more present in our daily lives, and consequently, should be recognized by the teaching-learning process (CORRÊA MAGALHÃES, 2003, p. 117).

Therefore, it is important for there to be non-linear dynamic interactions in the distance-learning environment to allow for the development of new means of structuring the experiences lived in said environment, and consequently, a new type of collective and collaborative thinking that can overcome time and space-related questions (LÉVY, 1999). In the perspective of the Ethnomathematics program, the technological approach to teaching allows for new cultural aspects in Mathematics to emerge in the distance-learning environment, but without the limits imposed by time and space present in the traditional model of teaching.

According to D'Ambrosio (1993), the methodology in the Ethnomathematics program is broad, as it focuses on the creation, production, organization, transmission and propagation of knowledge from the members of different cultural groups accumulated throughout history, and that are in constant evolution. In that sense, the Ethnomathematics program can be considered a theory of knowledge, as it incorporates scientific ideas and general knowledge. The program's proposition is to rescue and take ownership of the cultural mathematical memory (their codes and symbols, for example) of each member of said groups - such as the centers. Thus, each individual is an element of the group's cultural collective mathematical memory (HALBWACHS, 1950).

Based on this scenario, it is necessary to investigate the issues surrounding the teaching and learning processes of mathematical content related to the cultural aspects of the subject on the different levels of teaching. In such investigations, there is the need of considering contemporary trends in Mathematics Education, such as usage of the Ethnomathematics perspective and its theoretic-methodological referential, in order to enable improvement in the quality of Mathematics teaching, which happens in the distance-learning environment.

According to the National Curriculum Parameters - NCP (BRASIL, 1997), it is necessary to establish an approximation between common and scholar knowledge, so that the mathematical production of cultural groups can be used as starting points for learning mathematical content. Thus, one

of the pedagogical model's objectives to be used in the distance-learning environment is to prepare a curriculum that allows for the inclusion of knowledge built on the social practices of prospective teachers. In that sense, the Mathematics program can be regarded as a system of values and identity that represents knowledge that has been socially constructed inside each cultural group (MONTEIRO, 2004).

Sharing that point of view, distance learning can be viewed as a possibility for redefining the paradigm around the teacher-training program as it favors interaction among participants and facilitates conversations, exchanges and collective creation (PRETI, 2005). Therefore, teachers take on a new role in the Mathematics teaching and learning process in which, along with prospective teachers, a partnership is established.

Therefore, this kind of Mathematics program should be flexible and open to changes that can accommodate knowledge legitimated and validated by the various social practices. In D'Ambrosio's (2004, p. 51) point of view "the adoption of new educational stance is the search for a new educational paradigm that replaces the worn out teaching-learning model based on an obsolete cause-and-effect relationship". Thus, usage of the Ethnomathematics program in the distance-learning environment seems to be a pedagogical alternative to the teaching of Mathematics in the distance-learning teacher-training programs, as it raises important questions around the educational concept

and pedagogical practices explicit in that environment.

On the other hand, our point of view is that the model – traditional or distance learning – does not impact the quality of teaching. In that regard, pedagogical support adapted to the need and goals of prospective teachers and the development of the actual educational practice are the most important factors for enhancing quality in teaching, which does happen in the distance-learning environment. Therefore, it is of vital importance that the Mathematics teaching and learning process are based upon a didactic and methodological procedure of quality, rooted in solid conditions of advancements in pedagogical ideas that help prospective teachers to provide their own mathematical knowledge and develop it.

Therefore, there is the possibility of the Ethnomathematics program becoming a methodological potential for meaningful learning of content, facilitating building of mathematical knowledge in prospective teachers. This program has the important social role of using teaching propositions, aimed at pedagogical issues, and relates them to the political, social, economical, environmental and cultural contexts relevant to the teachers. In that sense, the main objective of the Ethnomathematics program is to associate mathematics to the cultural aspects of mathematical knowledge of different cultural groups (centers) by the appreciation of information exchange that takes place in the distance-learning environment.

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\* Editor's Note: all quotations are originally in Portuguese and were translated by the RBAAD's translation team for this publication.

However, it is important to highlight that an ethnographic investigation (FERREIRA, 1986) is necessary to verify the existence of cultural distinction between the centers. Another point to emphasize is the need for investigating which mathematical ideas are related to the cultural practices of each center. However, because the mathematical culture of each center might be related to scholar, academic and ethnocentric mathematics (which is also Ethnomathematics), it is of vital importance to verify how mathematical knowledge can be studied throughout the duration of the course, in order not to take the risk of obtaining mistaken interpretation from these different contexts. In that sense, Ferreira (1986) argues that there must be a constant concern with the operation of said proposition, as investigating knowledge on the development of a certain social group's (center) own development of mathematics entails a continued and systematic ethnographic investigation.

As education instructors in the Mathematics field, we can see the difficulties prospective teachers encounter in understanding the concepts of this area of knowledge. Therefore, we are challenged to investigate how to help these teachers obtaining theoretical and practical knowledge that allows them to reflect on their own pedagogical practice, and take a critical position on reality, while establishing relationships, in order to solve the many situations/problems that emerge from daily life at the distance-learning environment.

## THE ETHNOMATHEMATICS PROGRAM

In the distance-learning environment, Ethnomathematics can be considered

an area of Mathematics education that discusses the need for being attentive to common knowledge, relating it to the social, economical and cultural environment of pupils in the teacher training programs. With that perspective, D'Ambrosio (1990) states that Ethnomathematics can be understood as the art or technique (*techné* = suffix "-tics") of explaining, of understanding reality (*mathema*) in a cultural context (*ethno*). However, said author explains that he considers the prefix *ethno* in a much broader manner, because:

(...) *ethno* refers to identifiable cultural groups, such as national societies – for instance, tribes, union and professional groups, children of a certain age range, etc., and it includes cultural memory, codes, symbols, and even specific ways of thinking and interacting. In the same way, mathematics is also views in a broader manner, which includes counting, measuring, calculating, classifying, inferring and modeling (p. 17-18).

According to the definition supplied by D'Ambrosio (1990), we understand that pupils in distance-learning teacher training programs can be considered a society of professionals that perform mathematic activities in their daily lives. Therefore, it is indispensable that teachers-instructors enter the prospective teachers' universe by becoming familiar with the social and cultural aspects of the center's reality, in which they are not inserted. In such terms, it is important to clarify that "[...] mathematics practiced by different cultures, and different people in various times in history, and practiced by many today are Ethnomathematics" (D'AMBROSIO, 1999,

p. 35). Thus, it is necessary to investigate the learning and practices lived by pupils in the Mathematics teacher training programs of distance learning model.

In that sense, Vitha and Skovsmose (1977) state that four main research perspectives in Ethnomathematics should be studied. They are:

1) **Historic:** investigates the reconstruction of mathematics history in different cultures.

2) **Anthropological:** studies mathematical practices in identified cultural groups.

3) **Ordinary:** studies mathematical activity in non-scholar context, such as problem-solving strategies in everyday life.

4) **Educational:** investigates articulation of Ethnomathematics results with the Mathematics Education curriculum.

Our point of view is that understanding these four trends will help us grasp how mathematical ideas and activities vary among cultural groups in each center, as they may show the diversity of mathematical practices and strategies for problem solving embedded in the common culture of culturally distinct groups, such as professional and educational communities (centers). On the other hand, it is necessary for a teacher-training program based on the Ethnomathematics perspective to be organized in four fundamental stages (BELLO, 2004):

a) **Intentions:** in this stage, a discussion on the importance of incorporating local (center) mathematical practices in the school curriculum takes place with the teachers.

However, it is important that teachers-instructors are familiar with the problems faced by the school community, as well as with the students' local and sociocultural reality, so they can relate those issues with the proposed goals in the Pedagogical Project of the Course (PPC).

b) **Descriptions:** at this stage, relevant social practices for students of the centers are investigated and organized, then interpreted and analyzed within the theoretic framework of Ethnomathematics.

c) **Activities and curriculum components:** this is the stage where the investigation of convergence points between sociocultural and academic contents, and definition of guiding strategies for new pedagogical practices for mathematical knowledge acquirement takes place.

d) **Concepts, evaluation and continuity:** at this stage, it is necessary that the academic preparation be intensified. On the other hand, it is important to find differentiated means for information diffusion and pedagogical material production, as well as improved ways of maintaining the proposed pedagogical work for the mathematics program.

We understand that these four stages of Ethnomathematics perspective inclusion in teacher training programs also emerge in distance-learning environments, as there is a certain articulation in the professional development of prospective mathematics teachers, with the proposed Ethnomathematics curricula inside the limits of Mathematics Education. In that context, we agree with Arnold, Shiu and Ellerton (1996), who emphasize that sociocultural diversity

is vital in the development of curriculum activities related to local, national and international contexts and look into the local community (centers) impact on the teaching and learning process of prospective teachers.

In that context, Preti (2005) argues that one must consider the:

(...) historic-cultural context in which these formative processes took place in order to understand the limitations and practical pedagogical possibilities as collaborators in the process of student autonomy-building, in different dimensions and not only limited to autonomous learning, to independent studying (p. 129).

According to the author's point of view, we understand that it is possible to organize an environment of Mathematics learning in the distance-learning model, which favors both collective and individual progression of prospective teachers in the program with the support of the Ethnomathematics program perspective.

### **THE ETHNOMATHEMATICS PROGRAM AND THE DISTANCE LEARNING ENVIRONMENT**

In the distance learning environment, the Ethnomathematics program can contribute in promoting and offering intellectual tools for mutual respect and citizenship, as the program highlights creativity, stimulates cultural self-esteem and strengthens the respect for diversity by providing investigation, propagation and representation of both traditional and non-traditional mathematical concepts (FERREIRA, 1997). This approach highlights

pedagogical dimensions, such as interactivity, sociocultural presence and collaborative learning.

In that sense, the objectives in the distance-learning environment are in accordance with the Ethnomathematics program ideals, as a selection of interactive activities was made necessary – choosing problem-situations and meaningful examples, structuring them in a logical sequence so that they are not limited to observation and content absorption, but instigate action and investigation, considering the “professional practice as original place for creation and production of knowledge” (BORGES and TARDIF, 2001, p.15).

Thus, Ethnomathematics can be considered a system of knowledge that enables a favorable and harmonious relationship among the future teachers of the distance-learning training programs. In that sense, D'Ambrosio (1999) states that ethics and diversity ideals, such as respect for others, understanding differences, solidarity and cooperation are intrinsically related to the Ethnomathematics program objectives.

According to those objectives, the environment in distance learning searches for a new educational paradigm aimed at providing a full and wholesome training for teachers and make them professionals of conscious and critical minds through contact with new technology. However, distance learning must not be simply mistaken for the technology used in the environment around it, as it needs to be understood as a mediatized educational practice, an educational model created to facilitate access to knowledge. Therefore, it is a pedagogical alternative

with a practice rooted in ethical rationality, solidarity and committed to social changes (PRETI, 2005).

Such pedagogical approach is in accordance to the objectives of the Ethnomathematics program, as it allows for prospective teachers to become aware of the current development in technology and use instructional strategies that minimize teaching of Mathematics fragmentation with pedagogical activities, that link work and production, cognitive and emotional, individual and social. Thus, we agree with Miskulin (1999) when he states that it is fundamental for teachers-instructors to accept the new forms of knowledge, become familiar current Mathematics teaching trends, understand new ways of creating and master mathematical knowledge, understand new ways of production and appropriation of scientific knowledge and master the usage of new information and communication technology.

With respect to teacher training programs and the usage of new technology, it is important to highlight that:

In Teacher Training, it is required from teachers the ability to incorporate and use new technology in the learning process, which requires a new set up for the didactic and methodological process traditionally used in our schools, where the student acts as a mere receptor of information, and a critical insertion of those involved, adequate training and innovative projects. (MERCADO, 1999, p. 12).

Thus, technology takes on a fundamental role as it matches teaching methods and the

Ethnomathematics program, transforming them into working parts of the mechanism behind the virtual environment in distance learning.

In the teacher training process, the scope of the distance learning environment can be perceived as a teaching opportunity for the use of scientific method and research, to promote appreciation and investigation of the social, economical, political, environmental and cultural environment of the area covered by each center. In that sense, preparing the teacher-researcher at the distance-learning environment has become a necessity, as research is an important tool for prospective teachers to understand and grasp a reality in which they are not inserted, thus making interaction with said reality possible, which in turn results in benefits for all members of that community. With that perspective, Freire (2000) argues that:

Teaching requires research. There is no teaching without research and no research without teaching. These tasks are inside one another. While I teach, I keep on searching, researching. I teach because I search, because I have asked, because I ask and because I ask myself. I research to find what I don't know yet and communicate or announce the news (p. 32.)

Thus, it is important that the 'searching' and the 'asking' are also inserted in the preparation of teachers through the use of mathematical activities in the curriculum, experienced in the distance-learning environment. Therefore, research as a pedagogical tool enables prospective teachers to develop critical and reflexive thinking aimed at transforming the teaching



practice (ANDRÉ, 2001; PEREIRA, 2002). Consequently, it is important that teacher training, whether initial or continued, not be limited to:

(...) merely technical aspects, although they should not be neglected. The incorporation of reflection practice in the action, so that one is able to handle the many unpredictable situations, can be incorporated in training programs (QUEIROZ, 2001, p. 115).

Thus, the teacher-instructor needs to be not only a profound connoisseur of the topic, establishing an objective and communicative relationship with the students, but also needs to respect and consider the reality experienced and presented by the prospective teachers. Therefore, Ethnomathematics can be used as a teaching procedure that provides prospective teachers the necessary conditions for the creation and development of meaningful curriculum activities for learning Mathematics, based on pedagogical investigation.

### **TEACHER TRAINING IN THE DISTANCE-LEARNING ENVIRONMENT UNDER THE ETHNOMATHEMATICS PERSPECTIVE**

Most prospective Mathematics students continue to have a teaching experience associated with the traditional knowledge transmission model. Such learning models are solely based on memorization and training of routine procedures, and teachers of these methods were not generally involved in the construction of their own knowledge during their learning experience in school (CRAWFORD e ADLER, 1996). Our point of view is that such procedures should not be

adopted in the virtual environment of distance learning, because this teaching model can be defined as:

A continuous and inclusive project of developing physical, emotional and intellectual capacities based on cultural and moral values, allowing the individual to relate to the universe, [becoming] a builder of knowledge (VIGNERON, 1977, p.7).

Defining the role of teacher training in the distance-learning environment and the professional development of these teachers, in order to promote the necessary changes in Mathematics teaching and learning, is a complex task.

Therefore it is made necessary to consider the mathematical knowledge of prospective teachers under the Ethnomathematics perspective and its ideas on learning, in order for essential changes to take place in the teaching of Mathematics, which emerges in the virtual environment of distance learning. These changes must observe the comprehension and mathematical thinking of prospective teachers, the professional decisions on the curriculum content and the way of teaching so that mathematical communication happening in the distance-learning environment can be optimized and effective (ENGLISH, TIROSH, LESH and BARTOLINI BUSSI, 2005).

Because Ethnomathematics is an investigative field focused primarily on local systems of mathematical knowledge, its concerns with pedagogical objectives are multiple and varied because in today's world, sociocultural diversity is translated into

uneven scholastic success within the student body. Therefore, in order to better understand the Ethnomathematics proposition for professional training and development of teachers in the distance-learning environment, it is important to highlight the essential grounds of the Mathematics Education curriculum defended by this field of study. Such grounds are related to:

a) Involvement of the different cultures regarding the building of mathematical knowledge (ROSA and OREY, 2010).

b) The relationship between the mathematics curriculum and the prospective teachers' culture (ROSA, 2010)

c) Development of the curriculum from the students' cultural experiences (D'AMBROSIO, 1990; GERDES, 1996; ROSA, 2000; ZASLAVSKY, 1997)

From that perspective, Borba (1997) argues that it is paramount for Mathematics Education to be seen as "a process in which the starting point for teaching-learning of mathematics should be the Ethnomathematics of a given group and the objective would be the student developing a multicultural approach to mathematics" (p. 267). In accordance with that point of view, Gerdes (1996) argues that initial training of teachers should also prepare them to investigate:

(...) the ideas and practices of their own cultural, ethnic and linguistic communities and find ways of building their own knowledge from those ideas (...) and contributing for mutual understanding, respect and appreciation of (sub) cultures and activities (p. 126).

The Ethnomathematics perspective for teacher training programs and vocational development of each one of these professionals places the importance of theoretical-methodological and technological tools in the central role, acknowledging their ability to help these teachers understand and take pedagogical ownership of the diversity of mathematical activities emerging from the centers where they study, and in the communities where they perform their daily tasks.

In the virtual environment of distance learning, one of the main objectives of initial and continued mathematics teacher training is the teaching and learning of mathematics mediated by technology. However, it is also necessary to:

Review the teaching-learning process, prioritizing collaborative work among teacher-instructors and teacher-students and contemplating the main role the pupil plays in highlighting points of advancement and opportunity for improvement/renewal, contributing to the continuous self-training of the teacher-researcher and his/her practice. Perhaps this is one of the paths towards consolidating a culture of reflexive, investigative, questioning evaluation leading to the creation of new pedagogy – with technology – for face-to-face teaching and distance learning (CALIXTO, OLIVEIRA and OLIVEIRA, 2009, p. 9)

Therefore, it is important that pedagogical activities that take place in the distance-learning environment be prepared to accommodate these tools in the teaching and learning of mathematics, in the

organization of the pedagogical practice and creation of activities and didactic materials that do not include mathematical elements of many cultural heritages. Faced with that context, it is necessary for prospective teachers to assume the position of an Ethnomathematics investigator (STILLMAN and BALATTI, 2001).

We agree with that point of view because “problems in the building and management of the curriculum, as well as emerging problems in the professional practice in its many levels, require skills in problem solving and investigation from the teacher that stretch beyond mere common sense and professional goodwill” (PONTE, 2002, p. 7). According to this perspective, the resulting synthesis of mathematical knowledge research is the most important factor in pedagogical action for teaching-learning mathematics (BELLO, 2004).

On the other hand, one of the Ethnomathematics theoretic contributions for teacher training is to emphasize its pedagogical action, and also, the different ways to legitimize the knowledge acquired outside school and its environments. Therefore, this knowledge creates pedagogical possibilities for prospective teachers to “deal with learning that takes place inside and outside the school” (Domite, 2004, p. 420). Thus, we understand that local (centers) mathematical knowledge in the distance-learning environment introduces prospective teachers to different ways of thinking, reasoning and acting mathematically.

Conversely, these characteristics are usually immersed in other areas of knowledge and may lead to an interdisciplinary dimension

of knowledge, which is a fundamental characteristic of the Ethnomathematics program (D’AMBROSIO, 1990). Therefore, it is fundamentally important that we prepare prospective teachers to become investigators in Ethnomathematics, providing them with the necessary knowledge and tools for operating an inter- and cross-disciplinary dimension of the mathematical knowledge. Developing this investigative characteristic in prospective teachers is also an important aspect for mathematics teaching happening in the distance-learning virtual environment. In that respect, “teachers learn along with their students and continuously update their knowledge of the subject and their pedagogical competencies. Continued training of teachers is one of the most evident applications of the distance learning methods” (LÉVY, 1999, p. 9).

Examining the role of the educational role presented by the distance-learning environment is another important aspect of the Ethnomathematics perspective in the training of teachers. For instance, school remains a place for propagating knowledge, reflecting the relationships of power that takes place in social, cultural, political, economical and environmental settings. For these reasons, it is necessary that prospective teachers reflect on the social objective of scholastic knowledge, questioning the criteria used by the school to choose which knowledge to transfer. This approach allows for a critical analysis on how to choose among the pedagogical and methodological questions that reflect the cultural diversity of the local community (centers), and is focused on the mathematical knowledge previously acquired by the prospective teachers.

Similarly, the virtual environment in distance learning can be considered as a process essentially focused on the student, because:

A first path of extreme importance in facilitating operation of any DL experience is the emphasis in the interaction between students and teachers and amongst students; and creation of pedagogical and didactic support structures for the student (tutoring, counseling, stand-by support for questions, help in use of technology, etc.) These structures are especially important in a country like Brazil, where cultural and scholastic levels are, in general terms, not very high and the school does not provide their youth with tools for self-teaching (BELLONI, 1999, p. 102-103).

Faced with that perspective, Monteiro (2004) argues that:

The school as an institution needs to be prepared in order to become (...) more than a space for diffusion of knowledge; it will be necessary to create conditions for: dialogue between different types of knowledge; articulation between equal and different, between time and space, that is (...) the school is challenged to become a crossroad of different types of knowledge, languages, intercultural education and building of a new citizenship (p. 436).

Our point of view is that these reflections allow the virtual environment in distance learning to become an institutional place where different forms of knowledge can transit through, be discussed, debated and appreciated by all participants as a democratic process of teaching and learning mathematics.

In that sense, it will be essential that teachers-instructors acquire knowledge on the object of their work – necessary training, in order to effectively take on the role of mediators of knowledge – emphasizing, in a critical and systematic manner, the common mathematical knowledge among prospective teachers.

Faced with that context, the virtual environment of distance learning teacher training offers other advantages. Prospective students involved with said teaching method are required to be more attentive to the various media languages and learn how to work with technology and multimedia tools, maximizing and optimizing on-site moments, and developing better dialogue through different communication channels in order to maintain interactivity using different means, and pedagogical and methodological conditions (GATTI, 2005).

The purpose of the observation surrounding the educational role of the virtual environment around distance learning is to restructure the culture and the organization of said educational environment for the promotion of methods and techniques that facilitate scholastic success of prospective teachers through the use of pedagogy aimed at equality, which, in the case of mathematics teaching, runs through the integration of mathematics and the cultural background of these teachers. Therefore, the role of critic and observational mediators claimed by teachers who investigate local (centers) mathematic practices will only be developed within the distance-learning environment if the teacher training programs enable the necessary transformations in the curriculum, advocated by the Ethnomathematics program.

During the training process, prospective teachers acquire theoretic knowledge in mathematics, which allows them to consider the pedagogic practice and develop a critic opinion of their own reality. Thus, it becomes necessary to investigate how this knowledge is being studied and applied, and also which pedagogic practices these teachers may develop to enrich the knowledge that students build up from their social, cultural, environmental, political and economical reality. We understand that the Ethnomathematics program fits into that observation because:

The pedagogical proposition of Ethnomathematics is to turn mathematics into something that is alive, dealing with real situations in time (now) and space (here). And, through critical thinking, question the here and now. “By doing so, we dive into the cultural roots and practice the cultural dynamics” (D’AMBROSIO, 2002, p. 46).

Thus, it becomes necessary to create a log of the centers’ daily activity, of the prospective teachers way of thinking and of the pedagogical actions and practices developed in the context of physical and social spaces in which they live and work professionally. Therefore, André (2004) highlights that:

Through ethnographic techniques of participating observation and intensive interviews, it is possible to document what is not documented. That is, unveiling the hits and misses that permeate daily school practice, describing actions and representation of its social actors, reconstructing its language, forms of communication and the meanings created and recreated on

the day-to-day life of the pedagogical trade (p. 41).

Investment in teacher training through distance learning aimed at the context, environment and culture of prospective teachers is necessary due to the way in which teaching and learning of Mathematics is presented in the classroom: mechanic and divorced from reality. This traditional approach of Mathematics content makes it impossible for teachers to obtain minimum conditions for creating tools for research and analysis that are required during their teacher training program. In that sense, teacher training in mathematics inside the distance learning virtual environment needs to be implemented in situations and experiences derived from reality and context each center experiences.

### **ETHNOMATHEMATICS AS A METHODOLOGICAL PROCEDURE FOR THE VIRTUAL ENVIRONMENT OF DISTANCE LEARNING**

It is general knowledge that it is impossible for society to solve its greatest daily problems without the use of mathematics and its instruments. Mathematics is an important part of modern technological society. There are, however, other society pillars that are being overlooked – such as human relations – outshined by the search for mathematical knowledge of better quality. In that context, mathematics used in the school system is very specific and designed for the teaching of science and technology. That aspect of Mathematics teaching in contemporary society has its significance, as scientific knowledge is extraordinary and technology is sophisticated.

However, there are less sophisticated concepts that require help from science and technology, and use less refined mathematical content. For instance, a tribe's witchdoctor will not use an echocardiogram machine to check a patient's heart condition – he uses elements of a different nature to try and solve the same problem-situation (D'AMBROSIO, 2004). Our point of view is that indigenous, or local mathematics, is as valuable as academic mathematics because it is adequate to solve a problem-situation related to its sociocultural environment.

On the other hand, when prospective teachers solve calculation problems, they generally use a less sophisticated technology comprised of pencil and paper. When these teachers use books, they are using printed technology. When these teachers are working on an activity about the price of food products or doing research using the Internet, they are using a more advanced technology, which includes calculators and computers. In that sense, these teachers must be aware that all approaches have a cultural aspect related to the sociocultural environment in which they are inserted. According to that perspective, it is important to emphasize that technology and mathematics also complement each other through the Ethnomathematics program (D'AMBROSIO, 1993; ROSA, 2000).

Another important aspect for the methodological perspective of the Ethnomathematics program in the distance-learning environment is the incorporation of historicity of mathematical concepts in the pedagogical concepts, so that prospective teachers can consider the processes through which these concepts were elaborated, developed and

diffused. Thus, it is possible to show the presence of mathematics in everyday life and in the human development process. In that aspect, these teaching-learning situations can be contextualized and will then acquire sense and meaning, helping the manifestation of the necessary motivation for learning (ROSA and OREY, 2006). However, for that incorporation to be satisfactorily implemented, modeling must be used as a pedagogical tool for the Ethnomathematics program, in order to find adequate solutions for the daily problems faced by specific cultural groups, such as each center's participants (D'AMBROSIO, 1993).

According to Bassenazi (2002), Orey (200) and Rosa and Orey (2003), quite often, data obtained during modeling is essentially of Ethnomathematics nature, native to a community or center. Therefore, modeling as a strategy for teaching and learning of mathematics has proved effective, as it values previously acquired knowledge and encourages social action in prospective teachers, while Ethnomathematics as a pedagogical action reveals the potential of mathematics teaching with the use of modeling as an effective methodology for the program (D'AMBROSIO, 1993; ROSA, 2000; ROSA and OREY, 2010).

Thus, in order for a process of teaching and learning in mathematics to be developed from the knowledge prospective teachers build in the distance-learning environment, it is necessary to investigate the mathematical knowledge used in the daily community life of each center. Therefore, it is important that the constant contact with participants of each center is connected to the dialectic relationship that must be nurtured among the prospective

teachers, their teachers-instructors and the tutors (both on-site and remotely). This will allow for research and investigation to observe which activities related to mathematics education are more significant for the teaching-learning process in Mathematics.

In that context, as we challenge prospective teachers to learn through research, these professionals will be able to reproduce the methodology on their students. This is an extremely relevant fact, as mathematics content will then be absorbed in a meaningful fashion. Hence, such content can be studied within a context and from the prospective students own experiences in real-life situations. It must be highlighted that the role of the teacher-instructor in that learning environment is that of a mediator for the pedagogical work to be developed by prospective teachers in the distance learning virtual environment.

Therefore, it becomes necessary to bring the students sociocultural knowledge into the classroom (FERREIRA, 1986). Thus, when mathematical knowledge that prospective teachers acquire in the community (center) is used, mathematical concepts to be taught gain meaning as they are used in contextualized activities. In that sense, Freire (2000) states that teaching requires respect for students' previously acquired knowledge. Then, in order to teach mathematics in the distance-learning environment, it is necessary to respect previously acquired mathematical knowledge that prospective teachers bring with them to the learning environment. Freire (1983) has also previously emphasized that the pedagogical act is an action that starts from the students' reality and so that

students can then transform it with the help of others, through dialogue. In the case of distance-learning environments, dialogue happens with the use of new information and communication technology tools, which help prospective teachers to grasp reality, so that they can apply that knowledge in their community and contribute with tools for understanding and comprehending the problems it faces.

## FINAL CONSIDERATIONS

The Ethnomathematics proposition for professional training and development of Mathematics prospective teachers is in sync with the current trends in Mathematics Education, especially those that advocate for the idea of teachers-investigators, as this is a way to get them involved in the search for new mathematical knowledge and new pedagogical practices for the distance-learning environment. In that perspective, prospective teachers can develop specific abilities for investigating ideas and practices in Mathematics that take place outside the school (center) context and pedagogically develop them through contextualized activities developed in the distance-learning virtual environment.

In the educational context of Mathematics teaching and the distance-learning environment, it is important to highlight the urgent need to change the way didactic and pedagogic work related to the Ethnomathematics program is conducted. The majority of teachers do not use the Ethnomathematics program perspective in learning settings, such as classrooms and virtual environments, because they often

lack the proper training in implementing the educational trend in the school curriculum. Therefore, it is necessary for prospective teachers to develop instructional activities that facilitate contextualization and integration of academic and everyday knowledge, which would then be used in the pedagogical act of teaching and learning Mathematics. This would lead to the use of Ethnomathematics program perspective in the distance-learning virtual environment.

The importance of considering a few principles of the Ethnomathematics program for the creation of a mathematics curriculum based on that perspective is acknowledged. The investigation on the mathematical culture in centers may present operational problems, as teachers-instructors and both on-site and distance-learning tutors are required an advanced degree of acquaintance with the process. Despite the possible complications, it is still considered relevant to use a few of the methodological assumptions of the Ethnomathematics program when investigating distance-learning prospective teachers' mathematical knowledge, in the teaching and learning of Mathematics.

Therefore, it is important for teacher training programs, using either the traditional or distance-learning models, to have their objectives well defined and grounded on a solid educational proposition. Thus, it is important to consider that the distance-learning environment, combined with an educational project that addresses its specificities, should contemplate the training process, taking into account how prospective

students acquire mathematical knowledge and build their educational practices in the Ethnomathematics program perspective.

As a result, supported by the Ethnomathematics perspective, it is important to have appreciation for the experiences prospective students acquire in daily life, and acknowledge their space, roots, culture, and specially their mathematical knowledge. Thus, in the distance-learning environment, it is the teacher-instructors' duty to reflect on the pedagogical and methodological proposition and use it in that environment. From that proposition – and despite of it – teacher-instructors would be able to ensure the creation of more democratic distance-learning environments.

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\*\* TN: All titles were freely translated from the original in Portuguese.



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