Ethnomathematics: An approach to teacher perception in aboriginal communities in Peru

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Abstract: Ethnomathematics is the new approach that has mathematical education to favor learning in students of different educational levels. It is understood epistemologically as a teaching method that seeks to understand the different ways of knowing different minority cultures during a globalized society. For this reason, the objective was to interpret the experiences of the mathematics teachers of the Santa Clara of Uchunya community of Peru concerning ethnomathematics work. Methodologically, the research was approached from a qualitative perspective, making use of the interpretative paradigm through the ethnomethodological method. This research allowed the recognition of four units of analysis for the presentation of the results: a) Traditional mathematics and ethnomathematics, irreconcilable?; b) Ethnomathematics and knowledge management, fundamental pillars for the rescue of ancestral culture; c) Importance of ethnomathematics in the training process of Aboriginal students; d) Future challenges of ethnomathematics for the achievement of quality and inclusive education in Peru. The interpretation of the findings raises new questions: How can universities manage ethnomathematics training programs to achieve social gaps? Are Peruvian universities ready to transform their curricula and include training in ethnomathematics? What will be the policies of the Peruvian State to reduce social gaps through the implementation of ethnomathematics programs? What will be the educational reality in other Aboriginal populations regarding the perception of ethnomathematics?.

Keywords Ethnomathematics, teaching, indigenous education, indigenous populations, teachers

1. Introduction

Ethnomathematics is the new approach that guides mathematic education to promote learning in the students of different educational levels **(Viteri, 2015)**. However, the measures that should be implemented are limited due to the poor record of the experiences in these environments **(Castro et al, 2020)**.

Before starting the research process, it is important to understand that ethnomathematics has a relationship with anthropology and this is part of a construction of mathematic history and mathematic teaching **(Ambrosio, 2011)**.

The ethnomathematics' origin is based on the proposes of a different anthropologist who designed mathematics as a sociocultural construct that adapt to the local context, where it can develop, attempting an understanding of the world beyond academicist mathematics **(Aroca, 2016)**. Therefore, it is considered fundamental for knowledge management.

At the moment, it must be understood that ethnomathematics is not of recent date, on the contrary, its construction begins at the end of the last century and the beginning of this one, with the appreciations made by **Ascher (1994), Barton (1999), Oliveras (2006)**, who sought to understand the mathematics produced by ethnic minority groups in Latin American and the Caribbean **(Avila, 2014)**. However, this method is strengthened by the postulates of **D'Ambrosio (2008)** who also make an etymological clarification of it: "*Ethno* as the natural, social, cultural, and imaginary environment; *mathema* understood as explaining, learning, knowing, dealing; and *tics*, modes, styles, arts, and techniques" (p. 2). Therefore, ethnomathematics is understood as **Blanco, Higuita y Oliveras (2014)** explain: "...it is a "scientific program" whose purpose is to understand the different ways of knowing of the various cultures in their effort for survival and transcendence in the world" (p. 247).

The reports of experiences in researches about ethnomathematics are a variety and it corresponds to the perception of social diversity, for example, indigenous population **(Oliveras and Gavarrete, 2012; Olivas, Mancera y Romero, 2016; Martínez et al, 2019)**, Afro-descendants population **(Aroca, 2010; Valencia, 2014)**, rural communities **(Hernández, 2009)**, migrant population **(Martínez y Oliveras, 2015)**.

Therefore, this mathematical method is considered important, especially in aboriginal communities to achieve the rescue of the cultural heritage, which is considered as Intangible Heritage of Humanity.

In order to achieve the aforementioned, the ethnomathematical teaching process must be considered through knowledge management, which epistemologically, as **Nagles (2007)** explains: "...is a logical, organized, and systematic process to produce, transfer, and apply in concrete situations a harmonious combination of knowledge..." (p. 77).

Therefore, it should be understood that ethnomathematics should not be taken as a substitution for traditional mathematics; on the contrary, it should take place in a context where both can coexist, seeking the educational quality of communities traditionally marginalized and excluded from the quality and egalitarian educational process.

Under these considerations, the question arises: How do teachers working in indigenous communities in Peru perceive ethnomathematics? For this reason, it has been proposed as an object of study to interpret the experiences of mathematics teachers in the Santa Clara de Uchunya community in Peru concerning ethnomathematical work.

Thus, the research is proposed in three important sections. The methodology section describes the nature of the research, the study scenario, and the social actors involved in the work, as well as the strategies for data collection and analysis. The second section was called "presentation and analysis of the results from the ethnomethodological interpretation", where the findings obtained are interpreted and supported based on other research in the area. This section in turn is subdivided into topics that correspond to the main ideas of the social actors: a) Traditional mathematics and ethnomathematics, irreconcilable? b) Ethnomathematics and knowledge management, fundamental pillars for the rescue of ancestral culture; c) Importance of ethnomathematics in the training process of aboriginal students; d) Future challenges of ethnomathematics for the achievement of quality and inclusive education in Peru. Finally, it is presented the last consideration, where is considers about the findings of the realized work.

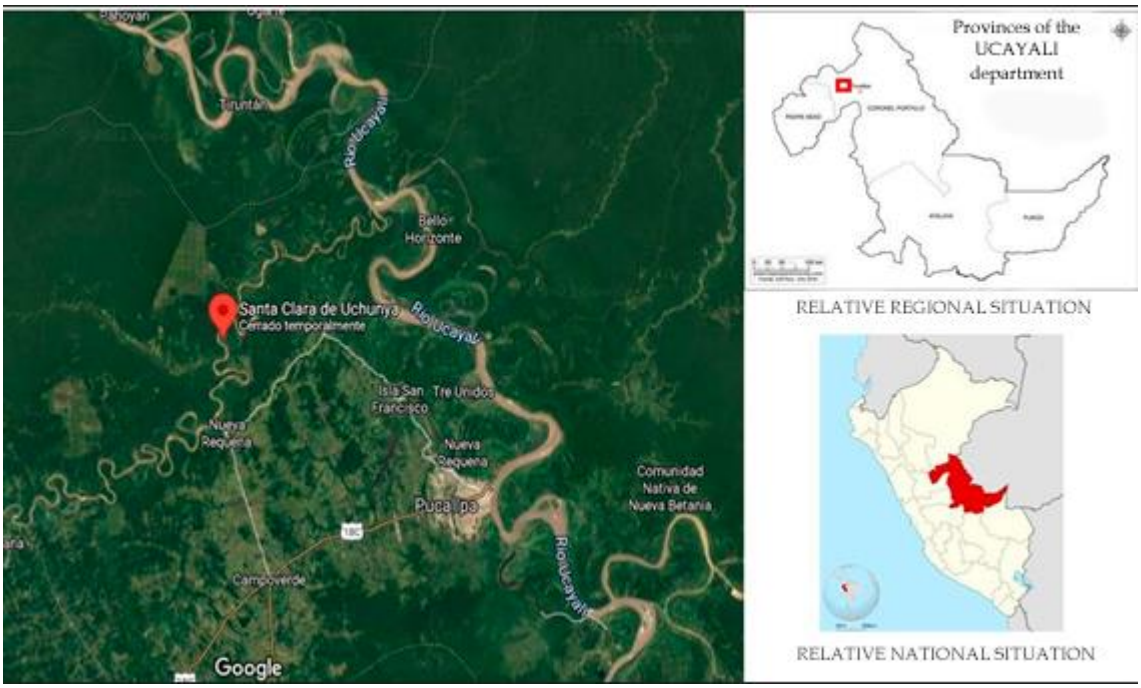
2. Methodology

The research was undertaken from a qualitative perspective using the interpretative paradigm, trying to comprehensively understand the object of study, avoiding manipulations that could arise due to the influence of external factors on the investigated fact. Therefore, the ethnomethodological method **(Martínez, 2010; Firth, 2010)** is used through the inductive approach, where the analysis is carried out through the emergence of categories during the interpretation **(Bisquerra, 2004)**, allowing reflection based on the participants' texts.

2.1. Area studies and social actors

The research made use of the native community Santa Clara of Uchunya as an area study, which is located in the Nueva Requena district of the province of Coronel Portillo, in the Ucayali department of the Peruvian Amazon (Figure 1).

Figure 1. Location of the area under study Source: Modified from Google Earth



The selection of this area is because it is an aboriginal community of the Shipibo-Conibo ethnic group, one of the ancestral ethnic groups that still survive within the Peruvian territory on the banks of the Ucayali River (UNICEF, 2012). Currently, the community is conformed of 250 people divided into 50 families (Pulido, 2020).

Nevertheless, for the selection of the social actors were taken into account the following criteria: a) teaching staff of the community, b) working in the mathematics area or elementary education, c) knowing the management of the ethnomathematics method. It allowed determining four participants that would conform to the social actors' group of the research.

2.2 Procedure for the information collection and treatment

For the collection of information, the interview technique was used. This technique is an unstructured type through e-mail, where the social actors were invited to reflect on three fundamental aspects: a) the difficulties of traditional mathematics in the education of the aboriginal population, b) the importance of ethnomathematics for the academic training of the indigenous population, c) future challenges of ethnomathematics for the achievement of quality and inclusive education in Peru.

This research made it possible to interconnect the categories identified in each of the interviews, so a pragmatic sociological analysis derived from the testimonies and actions of each of the social actors was carried out, contrasting with the opinions of research developed in this area.

3. Results' presentation and analysis of the ethnomethodology interpretation

In the following section, the results of the triangulation between the opinion of the social actors, the researcher, and the registered in the literature about ethnomethodology, according to the categories that were emerged during the discourse interpretation.

3.1. Traditional mathematics and ethnomathematics, irreconcilable?

[…] In addition to finding difficulties in the traditional mathematics teaching in the ancestral villages, I think that is about searching the balance among each other […] the mathematic will help the aboriginal youth people to emerge in the globalized context […] the ethnomathematics will be essential to contextualize the knowledge in the worldview of the village and maintain the ancestral knowledge […]

This category starts with the text aforementioned, which allows informing about the perception that mathematic teacher has of the teaching importance of both mathematics. Therefore, it can be understood that is not contrary and irreconcilable.

Traditional mathematics is in the globalized context, being important the teaching to offers to the students of the aboriginal ethnic the opportunity of personal and professional growth in a context beyond its community, which is the fundamental duty of inclusive education. Therefore, it should take into account the idea of Mendoza (2018):

...The right exercise of each group and the creation of conditions for the achievement of their learning depend on a quality differentiated education, as well as the gradual process and the long-term to generate conditions to truly inclusive schools (p. 14).

This makes it possible to understand that ethnomathematics is not seeking to replace traditional mathematics; on contrary, from the perspective of inclusive education, the teaching of both mathematics, supporting of quality education and social relevance.

Nevertheless, ethnomathematics is important for knowledge management with a focus to preserve the ancestral knowledge of the aboriginal villages. This idea could be proposed by one of the social actors in the following text:

[...] in indigenous education it is not a matter of leaving aside westernized knowledge, we seek in the midst of this westernization to find meeting points that allow us to recover the knowledge of our ancestors and implement it in current generations [...]. As elementary school teachers, ethnomathematics allows us to do so.

Once again, it is understood that is not about the predominance of a mathematic teaching method over the other one. It is about a coexistence that helps to rescue the indigenous knowledge in the case of the aboriginals. This situation was notified by Romero, Gamarra, and Miranda (2018):

The daily practice has all the mathematical knowledge of the native cultures to be transmitted through traditional action and these are related according to their worldview as it looks in the shipibo-conibo population in the learning process of the mathematics through the ethnomathematics that learns in the mathematical logic (p.47).

This idea has been observed in how the social actors recognize the importance of mathematics and ethnomathematics in the training process of the aboriginal communities. In addition, it was reflected that both mathematics make it possible to generate a progressive education with quality, with the purpose of inclusion and sustainable development of the natives' villages.

3.2. ethnomathematics and knowledge management are important foundations to the rescue of the ancestral culture

[…] our villages do not need great projects to rescue and preserve the culture […] as teaches, we have the biggest task to seek solutions in the communities where we work […] the biggest problem of our ancestral cultures is that orality has gradually disappeared, the youth people are increasing interest for the modernity […] strengthening in our education systems the ethnomathematics will be the fundamental foundation to preserve our traditions […]

As can be seen in the text aforementioned, the informants recognize the importance of ethnomathematics, as part of the knowledge management process, to rescue the cultural heritage of aboriginal cultures. They recognize this based on the danger of losing the intangible capital of the aboriginal people due to the disruption of the oral transmission of ancestral knowledge.

It is evidenced that the informants recognize the problem and seek to be part of the solution. This is not about a fact insolated, on the contrary, it has reported similar situations in other aboriginal territories in Latin American and the Caribbean. This is the case of Pérez (2004), who reports:

Besides ignoring the new conditions imposed by globalization, these social subjects made up of groups, communities, and self-managing organizations are convinced that another world is possible and that local cultures must be protagonists in it (p. 45).

Therefore, it is understood that the necessary social and cultural transformations to generate a rescue of the heritage inherited from the native peoples start from the management of knowledge in the area of education. Consequently, universities with competence in intercultural bilingual education must generate from social responsibility, training programs, and social action to achieve this goal.

In this regard, Román, Inche, and Chung (2010) express:

In a private or national university, knowing this capital is a vital aspect because represents its reason to exist, i.e., the investigation and knowledge generation. Therefore, it is necessary the knowledge management to measure and buy the intellectual capital that it has (p. 66).

Consequently, it is understood that the knowledge management and the ethnomathematics education programs development are fundamentals to collect, systematize, and report experiences of community-based research approach for the rescue and recovery of the native cultural traditions.

In this research have reflected and interpreted the importance, from the view of the social actors, of the ethnomathematics understood from the knowledge management, in the rescue process of the cultural heritage of the aboriginal population, being this knowledge and ancestral practices an intangible heritage of humanity with a risk to disappear due to globalized phenomenon and the digital knowledge era.

In addition, it was observed how the social actors and researchers in the Latin American and the Caribbean context report that the citizens of the aboriginal ethnic recognize the problem and seek alternatives to preserve the heritage. The important role of the emerged universities was to promote training policies and professionals' social commitment with the community where they are developed.

3.3. The importance of ethnomathematics in the training process of aboriginal students

The section aforementioned has shown how ethnomathematics is fundamental to the quality, integral, and inclusive training of the aboriginal ethnic, but it also has shown how it can help to the rescue of the cultural heritage. Therefore, the importance of it in the educational formation of Aboriginal students is taken for granted, but can there be more? It is presented a social actors' idea to answer this question:

[...] The importance of ethnomathematics lies in the fact that it allows us to recognize the historical, cultural, and social reality of each of the indigenous nations that made up our territory and that remain to this day [...] we cannot make the mistake of thinking that the reality of one indigenous group is the same as that of another [...] we are all different, we all have our own way of perceiving the world [...].

As we can see, the fundamental importance of ethnomathematics lies in its own epistemological principles, as it is also part of anthropology, it is open, flexible, and dynamic, so it seeks to develop in students a mathematical interpretation of the world from their own culture. Therefore, Blanco, Higuita, and Oliveras (2014) express: "Ethnomathematics studies the practices proper to the culture, practices motivated by the need to solve problems from which relationships with mathematics are woven" (p. 249).

These confirmations make possible the understanding of the importance of ethnomathematics through the following text:

[…] the good thing about the ethnomathematics is that can be adapted to the world's perception of each culture where this method is applied […] not only in the indigenous cultures […]

Consequently, it is assumed that informants recognize that the ethnomathematics not only focused in the social and cultural reconstruction of the aboriginal ethnic, but also it is applied in other minority population, according to the established by Blanco, Higuita, and Oliveras (2014):

...it is possible to realized researchers within Afro-descendants, homeless children, indigenous, mathematicians, carpenters, masons, farmers, dressmakers, or other communities. The group whose practices will be studied will be defined by the interests of the communities with whom the research is conducted (p. 27-28).

In this section, it has shown how the importance of ethnomathematics lies in the epistemic foundations that allow the contextualization, generation of knowledge, and its transmission through the adaptation of educational practices in the culture where it is applied. Therefore, it is recognized that not only can it be developed for the rescue of aboriginal cultures, but it can also help to carry out a sociocultural construction in pluricultural and diverse societies.

3.4. Futur challenges of the ethnomathematics to the achievement of quality and inclusive education in Peru.

Social and educational gaps have always existed in the country [...] the centralization of all services in some regions of the country has caused populations in the interior to be at a disadvantage before those who are educated in the capital cities.

[...] in order to build a fairer society, we must start from the understanding that our country is multicultural and diverse; not recognizing this will not help the advancement of quality and inclusive education [...].

As it can be observed in the text aforementioned, the social actors recognize a complex socio-educational reality that is developing in the country and is related to the pre-existing gaps in Peru. This is a situation that has been reported by Cuenca and Urrutia (2019): "...educational inequalities in Peru are not a resolved issue. Despite the progress made in reducing them, the gaps still persist and in recent years there have been signs of stagnation". (p. 457).

In this regard, social actors recognize which measures can help to reverse this situation, with ethnomathematics as a fundamental pillar. This assertion is supported by the following excerpt from the interviews:

The ethnomathematics programs must be a reality that comes from MINEDU, where the promotion of ethnomathematics is encouraged in order to reconstruct the mathematics that is in our societies [...].

Thus, it can be showed that ethnomathematics would be ideal to help aboriginal peoples, communities of Afro-descendants, migrant populations to develop their human potential to the fullest, recognizing the particularities of their cultures.

These ideas are related to the established by Rosa, Orey, and Gavarrete (2017):

Curricula should reflect the intrinsic, social, and cultural learning of students and teachers should be supported in their preparation to deal with such differences in order to promote a major change in the teaching of mathematics; where its main purpose is to favor equity for students, by allowing them access to know mathematics from different edges (p.84).

These approaches lead us to understand that training programs in ethnomathematics should be a State policy, allowing the adaptation of mathematical contents to the educational realities where they are developed, with the purpose to provide a social construction of knowledge, allowing the rescue and survival of aboriginal cultural practices and other minority groups that make up society.

Therefore, the school, as a social institution, must become a place where not only knowledge is transmitted, but also a social space for the coexistence of the different cultures that make up the nation through respect and recognition of the other, being the ethnomathematics fundamental to achieve this goal. These approaches are based on Peña, Tamayo, and Parra (2015):

Assuming the school as a place where individuals become subjects makes it the stage par excellence of ideological struggle and cultural resistance. It is in the school environment that minority groups can raise the need for coexistence among diverse forms of life, based on multiple cultural productions (p. 148).

In this section, it has reflected on the importance of ethnomathematics to achieve a fair, equitable, quality, and inclusive education, recognizing the cultural diversity that develops within Peru, but with special emphasis on the aboriginal communities, which for decades have remained on the margins of the country's social and economic development.

In order to achieve the postulates described in this research, the society must start from the transformation of public policies that help the application within the teaching of mathematics, ethnomathematical models, which are not antagonistic, on the contrary, they will allow a social and cultural opening within the management of knowledge to the construction of an equitable country with social justice.

4. Conclusions

The interpretation of the discourse through the ethnographic method allowed to discuss the research's findings, generate an approximation to the teacher's conception of the Peruvian aboriginal population of ethnomathematics, interpret them, and conceive new questions.

Regarding the discussion about the findings, it is understood that ethnomathematics is fundamental in knowledge management to rescue and preserve the ancestral customs that, currently, are at risk of loss. Therefore, it is necessary the intervention from the university to preserve the intangible heritage of the country.

In addition, it is understood that traditional and academic mathematics and ethnomathematics, in the case of indigenous populations, should form a proportional part of the curricula, based on the premise that both will help in the development of quality education in these areas. The first is because it is part of the common denominator that will provide opportunities for students to enter other academic spaces, and the second is because it is part of their historical and cultural heritage.

The political, economic, social, and cultural conditions that have prevailed in Peru during the last decades have led to a socio-educational panorama where gaps are part of daily life, making quality, egalitarian, and inclusive education a utopia.

According to this bleak panorama, ethnomathematics can become a solution that helps to close socio-educational gaps in all social aspects, since its application is not only focused on aboriginal populations, but is also used in other minority cultures such as Afro-descendants, migrants, children in poverty, and others.

Peru is a socially diverse and multicultural country, so ethnomathematics is one of the methodologies that can help through its epistemological foundations. Consequently, it is achieved a social cohesion, starting from the premise of respect for the other and the searching for greater social welfare for the educational development of the nation.

The social actors involved in this research will likely continue to carry out their educational activities in their settings. Their experience and history will be a fundamental part of achieving a socio-critical transformation.

This overview of understanding leads to suggest the development of participatory action type research where the emancipation of the communities under study is evidenced, with application in other minority cultures within the country. In addition, it is considered pertinent to approach life history research, which will generate new ways of understanding the ethnomathematics for knowledge management.

Considering that within the interpretive paradigm knowledge is an inexhaustible source and its construction is varied, other questions arise that may be part of future research, among which the following stand out: How can universities manage ethnomathematics training programs to achieve social gaps? Are Peruvian universities prepared to transform their curricula to include training in ethnomathematics? What will be the policies of the Peruvian State to reduce social gaps through the implementation of ethnomathematics programs? What will be the educational reality in other aboriginal populations concerning the perception of ethnomathematics?

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