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Indigenous ethnomathematics: knowledge and mathematical practices in the writings of graduates of intercultural teaching programs in Brazilian Northern Region[1]

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ABSTRACT

The objective of this research was to investigate indigenous mathematical knowledge and practices through ethnomathematics, from the perspective of indigenous graduates in their course completion intercultural writings. The methodology of the study involved bibliographic research with a qualitative approach. Seventeen course completion written by graduates available on the page of the Department of the Degree in Intercultural Education of the Federal University of Rondônia Foundation (UNIR) and the Indigenous Intercultural Degree Course of the Federal University of Amapá (UNIFAP) were analyzed. The importance of indigenous ethnomathematical elements as teaching and learning instruments in Indigenous School Education was noted in the academic productions. Such elements were contextualized for a better understanding of curricular contents and can be listed as teaching material, so that other indigenous teachers can use.

KEYWORDS: Ethnomathematics; Indigenous; Intercultural Graduation; Northern Region.

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Etnomatemáticas indígenas: saberes e fazeres matemáticos nos escritos de egressos de licenciatura intercultural na região Norte

RESUMO

O objetivo da presente pesquisa foi investigar os saberes e fazeres matemáticos indígenas, por meio da etnomatemática, na perspectiva de egressos indígenas em seus escritos interculturais de conclusão de curso. A metodologia do trabalho envolve uma pesquisa de cunho bibliográfico, com abordagem qualitativa. Foram analisados 17 trabalhos de conclusão de curso de egressos, disponibilizados na página do departamento da Licenciatura em Educação Intercultural da Fundação Universidade Federal de Rondônia (UNIR) e Curso de Licenciatura Intercultural Indígena da Universidade Federal do Amapá (UNIFAP). Notou-se nas produções acadêmicas, a importância de elementos etnomatemáticos indígenas como instrumentos de ensino e de aprendizagem na educação escolar indígena. Tais elementos abordados foram contextualizados para melhor compreensão de conteúdos curriculares e podem ser elencados, como material didático, para que outros professores indígenas possam utilizar.

PALAVRAS-CHAVE: Etnomatemática; Indígena; Licenciatura Intercultural; Região Norte.

Etnomatemáticas Indígenas: saberes y haceres matemáticos en los escritos de licenciaturas interculturales en la Región Norte

RESUMEN

El objetivo de esta investigación fue investigar los saberes y prácticas matemáticas indígenas, a través de las etnomatemáticas, desde la perspectiva de los egresados indígenas en sus escrituras interculturales al final de la carrera. La metodología del trabajo involucra una investigación bibliográfica, con un enfoque cualitativo. Fueron analizados 17 trabajos de conclusión de curso de egresos disponibles en la página departamental de la Licenciatura en Educación Intercultural de la Fundación Universidad Federal de Rondônia (UNIR) y la Carrera de Licenciatura Intercultural Indígena de la Universidad Federal de Amapá (UNIFAP). Se notó en las producciones académicas, la importancia de los elementos etnomatemáticos indígenas como instrumentos de enseñanza y aprendizaje en la educación escolar indígena. Dichos elementos abordados fueron contextualizados para una mejor comprensión de

los contenidos curriculares y pueden ser catalogados como material didáctico, para que puedan ser utilizados por otros docentes indígenas.

PALABRAS CLAVE: Etnomatemáticas; Indígenas; Grado Intercultural; Región del Norte.

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Introduction

Ethnomathematics, as a research program, holds significant importance for education in contemporary society. This program was launched internationally in 1984 in Adelaide, Australia, during the Fifth International Congress on Mathematical Education. D'Ambrosio introduced the Ethnomathematics Program, following Lakatos' understanding of a research program, with a focus on the generation and dissemination of knowledge.

Regarding the etymology of the word *Ethnomathematics*, D'Ambrosio (2011, p. 63) used "the roots tics, mathema, and ethno" to represent the techniques or forms (which are the *tics*) of dealing (which is the *mathema*) with various contexts of reality (which are the *ethnos*), thus forming the word ethno+mathema+tics.

Campos (2002) presents an extension of ethno-science. According to the author, "the ethno-x - where x is a discipline of the academia - emphasize in his researches the linguistic and taxonomic aspects, relegating to a secondary position the diversity and dynamics of the relationships 'human being of a given culture / nature.'" (CAMPOS, 2002, p. 47, author's emphasis). Thus, we have ethno-physics, ethno-architecture, among others.

The researcher Gelsa Knijnik (1996), in her work with members of the landless workers' movement in southern Brazil, presents an ethnomathematical approach to traditions and practices, investigating aspects related to the group's social, cultural, and economic capital, as well as their pedagogical work. The objective was to interpret the knowledge of the sociocultural group and establish connections with

academic knowledge, aiming to understand the power dynamics involved in these two forms of knowledge.

Thus, one of the objectives of the Ethnomathematics Program is to comprehend the generation and dissemination of knowledge of a sociocultural group, by problematizing everyday situations. D'Ambrosio (2011, p. 17) explains that the Ethnomathematics Program seeks to "understand mathematical knowledge/action throughout human history, contextualized within different interest groups, communities, peoples, and nations." On the other hand, we understand that it's necessary to relate indigenous knowledge to the academic knowledge in order to contribute to school teaching and learning processes. In the indigenous case, this means incorporating elements of indigenous education into indigenous school education. Mattos, Mattos, and Suruí (2020), highlight this connection with the Paiter Suruí people from Rondônia and Mato Grosso, who apply cultural knowledge from daily activities in the school context.

Similarly, ethnomathematical elements are brought up by Mattos (2020) in a study on the tical of mathema within the indigenous Wajãpi culture, which describes the indigenous Wajãpi people's methods of measuring and inferring, as well as those of other groups that employ the body as a measurement tool. The author correlates the body with forms of linear measurement, highlighting that the indigenous teacher should establish a connection between elements of indigenous education and school curriculum, and vice versa, with support from the Ethnomathematics Program.

On this subject, D'Ambrosio (1997) emphasizes the existence of various Ethnomathematics, and they cannot be ignored. According to the author, "The Ethnomathematics of the indigenous people serves, is efficient, and is suitable for very important things," similarly, the author states that "The Ethnomathematics of the white people serves for other things, equally very important" (D'AMBROSIO, 1997, p. 131-132), and that one doesn't supersede the other; on the contrary, mastering two or more correlated Ethnomathematics offers a better understanding of situations for problem-solving.

So, within this perspective of indigenous mathematical knowledge and practices, a bibliographic research was carried out with a qualitative approach. This research analyzed course completion papers from indigenous graduates of the Intercultural Education degree program at the Federal University of Rondônia (UNIR) and the Indigenous Intercultural Education degree program at the Federal University of Amapá (UNIFAP). The analysis focused on a pedagogical view of the concepts addressed in these papers, which are available on the respective department pages of both institutions.

In order to select the texts, all course completion papers related to the theme "Indigenous Ethnomathematics" were included in the research. These papers were retrieved from the databases of the institutions and the selection was limited to those that were defended between 2013 and 2018, considering that the repository was not updated after that. To achieve the intended objective, the identified materials were analyzed, and the papers that did not reference the research theme were excluded from the analysis.

A total of 17 course completion papers from the Intercultural Education degree program at the Federal University of Rondônia and the Indigenous Intercultural Education degree program at the Federal University of Amapá were analyzed. The research focused on traditional knowledge from various indigenous groups, including the Suruí, Cinta Larga, Karitiana, Cao Orowaje, Oro Win, Karipuna, Galibi-Marworno, Palikur, Djeoromitxi, and Tupari ethnicities.

About the research

Ethnomathematics studies as pedagogical practices are important in indigenous school education, as D'Ambrosio (2011, p. 3) highlights, "everyday life is impregnated with the knowledge and practices form their culture," and individuals are constantly "comparing, classifying, quantifying, measuring, explaining, generalizing, inferring, and in some way, evaluating, using the material and intellectual tools that are specific from their culture." So, in order to comprehend relationships that were

compatible with the theme "Indigenous Ethnomathematics," a search was conducted on the websites of universities in the Northern region.

Only two institutions yielded collections, totaling 141 Course Completion Papers, with 89 from the Indigenous Intercultural Education degree program at the Federal University of Amapá and 52 from the Intercultural Education degree program at the Federal University of Rondônia. Among these, only 17 papers authored by indigenous students were relevant to our topic, and they are detailed in Table 1. It is important to emphasize that five out of these 17 papers do not have a direct thematic link to Ethnomathematics, although such a relation does exist.

The text by "Anatana dos Santos and Maria Sônia Aniká" discusses the conservation of cultural heritage in relation to craftsmanship, focusing on the study of "kuahí graphic patterns on the body and gourd." In the text, despite of these elements, the authors do not establish a connection between the graphic patterns and ethnomathematics.

The same aspect is also observed in the text by Nordeval dos Santos, which aimed to identify and describe the modes of artisanal production of various types of crafts created in the Kumarumã village by the Galibi-Marworno indigenous community, as basketry, sculptures, feather arts, utilitarian objects, and costume jewelry.

Similarly, Maurício Galibis Nunes' text describes the Kuahí graphic patterns and their variations. The author presents paintings and crafts in the text that are related to geometric shapes such as rhombus and triangle, but does not establish a direct connection between these ethnoknowledge elements and ethnomathematics.

Likewise, a similar situation is observed in the texts by Edineuza Miranda Nunes and Alina Jabuti. In the first text, the author discusses the counting of time, while in the second text, the author addresses body painting. However, neither of these texts directly approaches ethnomathematics (although a relationship does indeed exist).

Table 1 contains a list of the 17 course completion papers authored by indigenous students that were obtained from the collections of the Indigenous Intercultural Education degree program at the Federal University of Rondônia and the Federal University of Amapá.

TABLE 1: Indigenous graduates's productions compatible with Indigenous Ethnomathematics.

Year of Defense	Author	Ethnic group	Paper Title	Institution
2013	Anatana dos Santos and Maria Sônia Aniká	Karipuna	Karipuna indigenous art: a study of Kuahi graphics on the gourd and on the body	UNIFAP
2014	Alarcidio Figueiredo Narciso	Galibi-Marworno	Measurement systems in labor practices in the Galibi-Marworno culture: an ethnomathematics study	UNIFAP
2014	Jaizinho Mauricio Monteiro and Izardes Charles dos Santos	Galibi-Marworno	Plane geometry and indigenous marks of the Galibi Marworno culture: a reflection on teaching materials	UNIFAP
2014	Nordeval dos Santos	Karipuna	Galibi-Marworno handicrafts: a descriptive study of cultural and traditional objects	UNIFAP
2015	Alina Jabuti	Djeoromitxi	The Djeoromitxi people's body painting	UNIR
2015	Benjamim Mopidakeras Suruí	Suruí	Difficulties in teaching and learning mathematics at the Noá Suruí indigenous school	UNIR
2015	Salomão Oro Win	Oro Win	Introduction to the mathematical knowledge and practices of the Oro Win people	UNIR
2015	Augusto Cinta Larga	Cinta Larga	Mathematical knowledge and practices of the Cinta Larga people	UNIR
2015	Luiz Carlos Karitiana	Karitiana	Mathematical knowledge and practices of the Karitiana people	UNIR
2015	Wem Cacami Cao Orowaje	Cao Orowaje	Mathematical knowledge of the Cao Orowaje people	UNIR
2015	Adriano Pawah Suruí	Suruí	Mathematical knowledge of the Paiter Suruí people	UNIR
2015	Mopidaor Suruí	Suruí	Time markers of the Paiter people: subsidies for the differentiated teaching of mathematics in the village school	UNIR
2015	Geovane Tupari	Tupari	Learning difficulties in mathematics in schools at Rio Branco indigenous land	UNIR
2016	Edielson Iaparrá Labontê	Palikur	Ethnomathematics and Palikur indigenous school education: knowledge of cassava flour production in Kumenê Village	UNIFAP
2016	Edineuza Miranda Nunes	Galibi-Marworno	Counting time for the Galibi-Marworno from Kumarumã village	UNIFAP
2016	Maurício Galibis Nunes	Galibi-Marworno	Galibi-Marworno art: a study of the variation in Kuahi graphics in Kumarumã village in Uaçá region	UNIFAP
2018	Rosival Anika dos Santos	Karipuna	Basketry and tracing: a study in indigenous ethnomathematics	UNIFAP

Source: Elaborated by the authors (2022).

Out of the 17 course completion papers analyzed in the research, 9 (which corresponds to 52.9%) were authored by graduates of the Intercultural Education degree program at the Federal University of Rondônia (UNIR), and 8 (which corresponds to 47.1%) were from the Indigenous Intercultural Education degree program at the Federal University of Amapá (UNIFAP). Regarding the ethnicities of these graduates, the most represented were the Galibi-Marworno ethnicity, with 4 papers (which corresponds to 23.5%), followed by Suruí, with 3 papers (which corresponds to 17.6%), and Karipuna, with 3 papers (which also corresponds to 17.6%). The remaining seven ethnicities, Tupari, Djeoromitxi, Palikur, Oro Win, Cao Orowage, Cinta Larga, and Karitana, had one paper each (which corresponds to 5.9% of the total papers each).

The themes explored in the research of the Course Completion Papers listed in Table 1 will now be discussed in the Results and Discussions section. The aim was to systematize and record the ancestral knowledge and indigenous ethnomathematical elements present within the ethnicities of the Northern region of Brazil.

Results and Discussions: mathematical knowledge and practices of indigenous peoples

In his text, Cinta Larga (2015) discussed the indigenous education knowledge, combined with indigenous school education through the process of crafting baskets, necklaces, baskets, bracelets, arrows, arrow ornaments, as well as in the construction of houses and various other types of artisanal productions made by the Cinta Larga people.

This connection between indigenous education and indigenous school education is evident in the text. The author highlights that within the process of crafting a basket, there are several possibilities to

incorporate formal mathematics education, such as operations, measurements, geometric shapes, and more.

In this direction, Mattos and Ferreira Neto (2019, p. 64) state that the classes based on the mathematical knowledge and practices of the culture "not only reclaim the knowledge of their people, but also make geometry classes more engaging" by using the artistic creations of the culture as teaching tools.

Regarding this aspect, Santos (2018) brought about the revitalization of basketry, such as pannier and sieve, presenting the raw materials, extraction techniques, and durability. The author discusses what the process of crafting baskets offers to the basket maker and the community indirectly, encompassing aspects like raw material collection and the basket maker's perspective while utilizing crafting techniques. The indigenous teacher states that "in a sieve, we can find geometric shapes like triangle, square, rhombus, trapezoid, and rectangular forms, among others" (SANTOS, 2018, p. 14), highlighting the connection between ethnomathematics, indigenous education, and indigenous school education.

Indeed, as an engaging lesson proposal, the indigenous teacher presented a study plan with the intention of using basketry as a teaching and learning tool. The objective was to teach geometry concepts, flat and three-dimensional geometric shapes, length, width, area, and capacity measurements.

The concern to incorporate concepts from traditional indigenous culture into indigenous school education is evident in several texts. According to Mopidaor Suruí (2015):

> [...] it is necessary for us to study indigenous and non-indigenous mathematics, and this research can even contribute to the math teacher's class, and that's how the Paiter schools incorporate ethnomathematics into their education. Our system of time markers is different from the surrounding society, as it lacks counting measurement units and is more related to natural phenomena. (SURUÍ, M., 2015, p. 52).

Indeed, there is a clear concern to keep ancestral knowledge alive, but it's recognized that non-indigenous culture does exert some influence within the community. It's important to acknowledge the significance of both cultures, yet it's essential to document indigenous knowledge and practices as pedagogical material and prevent non-indigenous culture from overshadowing indigenous culture.

In this vein, in Monteiro and Santos (2014), we see that indigenous teachers of the Galibi-Marworno ethnicity use their ancestral knowledge as a tool for teaching and learning, making their classes more engaging. According to Mattos and Ferreira Neto (2019), this contributes to the transformation of the Western mathematical mindset within indigenous school education.

In this direction, Monteiro and Santos (2014) show that indigenous teachers from the Galibi-Marworno ethnic group use the ancestral knowledge of their people as a tool for teaching and learning, making classes more attractive. According to Mattos and Ferreira Neto (2019), this contributes to transforming the way of thinking about so-called Western mathematics in indigenous school education.

The authors Monteiro and Santos applied a pedagogical material proposal in their research within a high school context and, in order to achieve their objective, they utilized 13 indigenous marks from the Galibi-Marworno people through an intercultural approach. During the workshop conducted with students, one of the participants, when asked about which geometric shapes an indigenous or non-indigenous teacher could work with Mak Kuahí in high school, responded that:

> One of the geometric shapes that teachers could work with the Mak Kuahí is the triangle and rhombus shapes in mathematics. It's a discovery for us that our cultural marks are being used in the study of mathematics. This is of great importance for us, because we usually see our cultural wealth being used only in our daily life (MONTEIRO; SANTOS, 2014. p. 17).

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The participant's statement reveals a form of contextualizing triangles and rhumbuses within indigenous school education by using elements from their culture. Therefore, bringing cultural knowledge into the indigenous school classroom, especially in mathematics, not only preserves indigenous knowledge and practices, revitalizing them, but also enables a more enjoyable learning experience rooted in the community's daily life and without the interference of non-indigenous influences.

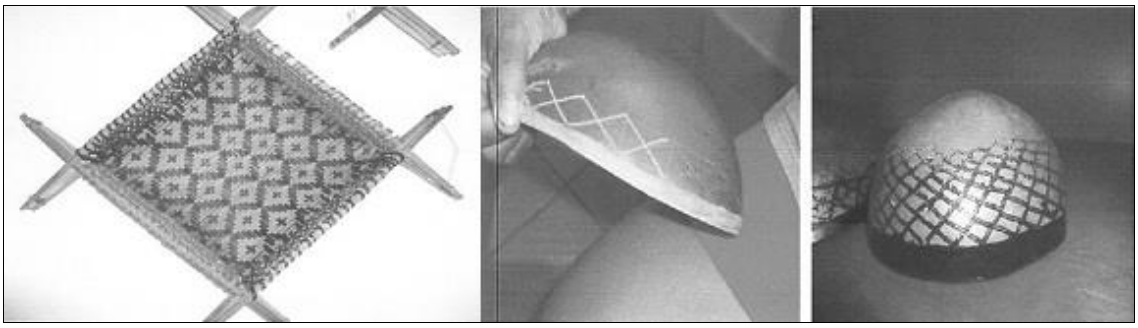
The reflections of indigenous students on the correlation between the use of Galibi-Marworno Cultural marks were documented, and it's worth noting that three Galibi-Marworno indigenous students evaluated the cultural marks as instruments for creating pedagogical teaching materials (MONTEIRO; SANTOS, 2014).

According to the authors, the marks of the Galibi-Marworno people can be used to create teaching materials for both indigenous and non-indigenous schools. The production of specific mathematical materials can contribute to teaching indigenous and school knowledge through an intercultural teaching practice.

The authors present an action plan to concretize these ideas, which involves discussing the valorization and strengthening of indigenous students' identities through indigenous marks; conducting research on these marks and how they can be used in teaching school mathematics; producing books that address the creation of specific teaching materials in light of ethnomathematical theoretical frameworks; and ensuring that these books reach the schools in indigenous villages.

In the same context regarding the Kuahí mark, Santos and Aniká (2013) identify and describe the Kuahí graphic patterns used in gourds, sieves, panniers, and body paintings (Figure 1). They address mythological aspects of Karipuna culture, based on discussions about Intangible Cultural Heritage, which consists in a pattern in the Kuahí design, formed by the geometric rhombus shape, which symbolizes a fish from the region.

FIGURE 1: Kuahi marks in the manufacture of sieves and gourds.



Source: (SANTOS; ANIKÁ, 2013, p. 16-18).

Santos and Aniká (2013, p. 05) describe and explain the meaning of the "mak kuahí" mark as "the design presents a type of fish (species of fauna) in the form of a rhombus (geometric shape), which is used in various handicraft objects[...]", therefore, it holds an equivalence with the triangle and rhombus rhombus shapes. They conclude about the significance of their study by stating that:

> The investigation of this field research has added a scientific experience to our professional lives as teachers and researchers in the village, where we have learned to value the use of Kuahí graphic pattern and we have also had the opportunity to witness the production of gourds and body paintings by skilled artisans, which is why we believe that information on culture is necessary for indigenous school education and for the Karipuna tradition [...] (SANTOS; ANIKÁ, 2013, p. 29).

The authors' concern is evident in their efforts to document and share the production of significant knowledge from the Karipuna culture within the context of Arts education in indigenous schools. These artistic techniques can contribute to the teaching of mathematical concepts while also reinforcing and recognizing the potential of Karipuna Culture in teaching and learning processes.

In the same context, Karitiana (2015) focused on valuing the knowledge of the elderly, understanding the traditional Karitiana way of thinking, demonstrating and applying Karitiana ethnomathematics, contributing to the teaching and learning process, and strengthening the culture of their people. This contribution is evident in their interview with a knower, during the process of constructing a traditional communal dwelling known as a "maloca" (Figure 2):

> [...] before constructing the oca, the elderly used to take a piece of stick and lay it on the ground, tying a vine on the opposite side. Then they stretched another stick to create a circumference using the vine [...]. After drawing the circumference on the ground, the length of the sticks (rafters) was measured by walking steps. This i show the maloca was built in the past (KARITIANA, 2015, p. 19).

FIGURE 2: Circumference on the ground in the construction of a traditional maloca.

Source: (KARITIANA, 2015, p. 20).

Techniques of indigenous Karitiana mathematical knowledge and practices being applied and passed down to future generations can be observed. Also, the tools used to build the maloca, such as vines, sticks, logs,

as well as the the babaçu tree leaves used for roofing, are sustainably sourced from the forest. It is important to note that indigenous knowledge is transmitted by those who know the culture, often referred to as "the elderly", as these individuals are the primary custodians of millennia-old ethnoknowledge, which has been passed down from ancestors.

In Cao Orowaje's (2015, p. 20-21) research titled "Mathematical Knowledge of the Cao Orowaje People", obtained as a result, and recorded, concepts of "quantifiers, geometric qualifiers, relative positions, time markers and counting and quantification operations in the Cao Orowaje language with a Portuguese translation and a contextualizing sentence".

With regard to quantifiers, we highlight the numerical sequence that starts from the number one to the number ten, and continues with other terms such as half, little, a lot, whole, part, infinite. As for geometric qualifiers, we see the terms circle, thin, thick, shallow, deep, high, low, fat, thin, big, small, open, closed, round, flat, long, short, straight, crooked, flat, smooth, rough, full and empty. The relative positions recorded are far, near, right, left, behind, in front, below, above, side by side, here and there. Time markers and quantifiers are recorded as old, new, yesterday, today, tomorrow, rainy season, dry season, day, night, beginning of the day, noon, beginning of the night, middle of the night, morning, afternoon, dawn, formerly, before, after, now, never and always. Counting and quantifying operations include adding, dividing, adding, removing, decreasing, increasing, repeating and canceling. It is worth noting that the author has translated into Portuguese, always contextualizing with two sentences, one in the mother language and another in Portuguese.

This contributes to the preservation of ancestral knowledge and other rights acquired by indigenous peoples with the enactment of the 1988 Constitution of the Federative Republic of Brazil (BRAZIL, 1988), which, in its Article 210, guarantees indigenous peoples basic education based on ethnic values, their knowledge and traditions from their ancestors, transmitted orally, that is, through their mother language, their customs,

artistic productions, forest conservation, sustainability, subsistence, way of living and understanding mother nature.

In the same vein, the 1996 National Education Guidelines and Bases Law (LDBEN) (BRASIL, 1996) establishes in Article 78 that the education offered to indigenous people must provide their communities with the recovery of their historical memory, as well as the reaffirmation of their ethnic identity and the valorization of their mother language. Therefore, the State is largely responsible for ensuring the rights of forest peoples, for intercultural, bilingual and differentiated education, safeguarding cultural origins, values and traditions.

Coming back to Cao Orowaje's text, we can see that there is indigenous knowledge and practices that have not yet been used as tools in the teaching and learning process in schools in the communities of the Cao Orowaje people. This sparked the author's interest in working on the concepts with his students at school, helping to value the knowledge and practices of the Cao Orowaje people.

We noticed mathematical concepts such as the term "pyramid", which he was unable to identify or which does not exist in the language of the Cao Orowaje people. In response to this, the author proposes a collaborative approach involving indigenous knowledge holders and the community to detect or name terms that may not have direct equivalents in the Cao Orowaje language. He emphasizes that this naming process "will not be difficult to create because we have already created several names for other objects that did not exist in the culture of the people". (CAO OROWAJE, 2015, p. 29).

In this respect, Adriano Pawah Suruí (2015) points that:

> In some cases, it was not possible to identify in the Paiter language and culture during the research one or other mathematical concept that exists in school mathematics. This does not necessarily mean that these concepts do not exist or that they are not possible to be conceived in Paiter, but only that in this research it was not possible to identify them yet (SURUÍ, A. P., 2015, p. 32).

The author emphasizes that teachers can use contextualized concepts and examples as didactic materials in the teaching and learning process of students in the classroom, "These materials are important to facilitate student learning, to value traditional culture and to insert new pedagogical practices in the school towards intercultural education" (SURUÍ A. P., 2015, p. 44).

In the same way, to record the mathematical concepts of indigenous culture can also be seen in Oro Win's research (2015, p. 07), which aimed to record the people's mathematical knowledge related to numerical terms, geometric shapes, measurements and other knowledge used in everyday activities such as fishing, hunting, farming and others. This Oro Win ethnomathematical knowledge was recorded and contextualized in their mother language and in Portuguese, so that it could be better understood, the culture's mathematical knowledge and practices could be valued, and it could be used to support specific teaching materials for mathematics in Oro Win schools.

This knowledge, which is not currently used as a tool in the schooling process of the Oro Win people and has no records, in other words, the ethnomathematical knowledge of the Oro Win people was being left aside and lost over time. The only specific mathematics considered in the community's school is Western mathematics. With this in mind, the author emphasizes the relevance of records, deepening of concepts, new practices, intercultural education and as a theoretical and empirical reference in the continuing education of the Oro Win people.

Thus, Oro Win's mathematical knowledge is highlighted, aligning with the expressed by D'Ambrosio (2011, p. 22) when he says that "among the different ways of doing and knowing, some privilege comparing, classifying, quantifying, measuring, explaining, generalizing, inferring and, in some way, evaluating". There is a necessity and concern to record and keep alive ancestral knowledge of

"explanations and ways of dealing with the immediate and remote environment. Obviously, this mathematical knowledge/doing is contextualized and responds to natural and social factors".

In this direction, Labontê's (2016) research aimed to investigate the ethnomathematical knowledge present in the flour production of the Palikur people, in the Kumenê village, located in the municipality of Oiapoque, in the state of Amapá. The Palikur people's flour production process is divided into 15 (fifteen) stages: "clearing, felling, burning, mowing, planting, weeding, harvesting, scraping, washing, grating, mixing the dough with the cassava in the water, pressing, sieving the dough, roasting, sieving the flour" (LABONTÊ, 2016, p. 14). This confirms what D'Ambrosio (2011) said, that the practice of agriculture has been developed for thousands of years and has been the most important practice of humanity, because it is where people found their food.

Labonté's work (2016) shows various mathematical concepts, ranging from the choice of area and measurements of the space for planting, to the environment in which the flour is prepared. The techniques point to various opportunities, such as tools in the math teaching and learning process, interdisciplinarity, a distinctive teaching resource and educational interaction.

The reports of indigenous people are in line with the establishment of interdisciplinary relationships with elements of ancestral knowledge that can be developed in indigenous school education. This is supported by Mattos, Mattos and Souza (2019), in the speech of an indigenous teacher who brings evidence of concepts from Mathematics, Geography, Biology, Environmental Education, Sustainability, Agroecology, Agroecological Practice and Cultural Knowledge, in a reforestation project that can be practiced in indigenous schools:

> In this project that was done in our community, it was to help the students to plant in places that have been deforested, right, by

> the, at the time of contact [...]. These issues involve mathematics in terms of measurements, in the days that the plant evolves. A discipline that we always put together, you know, geography, a discipline that we do a study that is called multidisciplinary, you know, that includes other disciplines so that it can help you understand and the students to know this knowledge [...] (MATTOS; MATTOS; SOUZA, 2019, p.10).

The reforestation project described in the indigenous teacher's speech is a pedagogical action involving sustainability and environmental preservation, developed on indigenous land, due to the impacts caused by non-indigenous people, such as burning and logging. This project is accepted and recognized as very important by the school community.

Narciso (2014), an indigenous person from the Galibi-Marworno ethnic group, recorded in his research his own system of measurement, which is different and used constantly, even after the contact with non-indigenous people. For the unit of measurement of length: a normal man's arm, old meter, finger, key and span. For the unit of measurement of width: old meter, finger, key and span. For the unit of measurement of thickness: inch and finger. And for the unit of measurement of land area: maritime arm, which is the measure of "a man standing with his arm stretched upwards and holding a large machete. This measurement goes from the tip of the man's toe to the tip of the machete, measuring upwards along a stick in na upward direction" (NARCISO, 2014, p. 12).

Even though the Galibi-Marworno people are aware of the existence of the international system of measurement taught at school, they make little use of it. They recognize the need for their own mathematical knowledge to be taught in the community's schools.

The Galibi-Marworno people's distinctive system of measurement is transmitted by their elderly through orality, which can be seen in the

speech of the indigenous Galibi-Marworno interviewee Adailson dos Santos Narciso.

> The measurements we use are important for indigenous schools. If we stop measuring in our own way, our children and grandchildren will forget this knowledge. We need to teach them our measurements, to preserve our culture and for the indigenous school to pass on this knowledge from generation to generation. I do this work almost every day and all of this is indigenous mathematics (NARCISO, 2014, p. 16).

Alves and Mattos (2022, p. 58) point out that "each ethnic group finds its own way of passing on ancestral knowledge to younger people". Such transmissions are made orally by those who know the culture or are also called "elderly", who are "those who have an understanding of the culture before contact with non-indigenous people". Indigenous peoples appreciate academic mathematics, they compare it with nature, phenomena and cosmology, they understand its importance in everyday life and in society in general, but they also recognize that indigenous mathematics must not be forgotten, but propagated.

In his research, Santos (2014, p. 05) described traditional techniques in the production of handicrafts and artifacts by the Galibi-Marworno indigenous people "such as basketry, sculptures, feather arts, utilitarian objects and costume jewelry" which, at present, young indigenous people have little interest in. Indigenous peoples are great artists, and these artifacts are produced according to the need for survival and daily tasks such as hunting, fishing, festivals, rituals, typical foods, among others of each culture. Nowadays, these objects are being replaced by industrialized objects and are no longer being made, causing concern for the Galibi-Marworno knowers.

On the other hand, Nunes E. M. (2016) tried to point out the time counting of the Galibi-Marworno from the Kumarumã village, which links nature, its elements and species with the chronology of time, an instrument that will guide the Galibi-Marworno people with the seasons of the year, rainy season, summer, when to plant, cultivate and harvest.

This familiarity and reverence of nature with indigenous culture can be found in the text by Santos and Aniká (2013, p. 09), who verified and discussed the ancestral knowledge of the Karipuna people from the Manga village, in the Uaça indigenous land in the far north of Amapá, propagated in history, recognizing, strengthening and registering this cultural knowledge and practices with a bias towards the "Kuahí graphics on gourds and bodies, characterizing a decorative pattern in the design of the kuahí, which is formed by the geometric figure (rhombus)".

Kuahí graphics, which came about through a Karipuna Pajé and therefore have a spiritual essence and value, can be found in drawings on Karipuna handicrafts such as panniers, oars, baskets, sieves, gourds and body paintings.

Also, in the text by Nunes M. G. (2016), we see that:

> The "gourd" represents a symbolic and utilitarian object in the daily life of the community, used for eating, serving flour, tucupi, xibé (a drink made from water and flour). Today, the craftswomen use the markings on the gourds, representing individual designs, with geometric shapes that signify elements of mythology, animals and plants that are important to indigenous culture (NUNES, M. G., p. 16 author's emphasis).

Nunes M. G. (2016, p. 15), "mentions the types of Kuahí graphics and their variations according to traditional knowledge and their manufacture on craft objects and in ceremonial events such as the Turé ritual". The term Kuahí is called a mark for the indigenous Galibi-

Marworno, which is the name of a little fish in the shape of a rhombus. The graphics "represent elements of nature such as plants, animals that present drawings, paths, figurative trails that signify scenes from their daily lives and mythological tradition".

Kuahí graphics are being preserved and used to make artistic objects in the Galibi-Marworno culture, as well as being used as a tool in the teaching and learning process in indigenous school education.

For Jabuti (2015, p. 16), in the body painting of the Djeoromitxi people, the knowledge and practices are being preserved and their dissemination "usually takes place during the chicha [a fermented drink produced by indigenous peoples], from which I learned the stories, myths and meanings of Body Painting by listening to my aunt and cousin during these festivals". The author describes how the paints are prepared, using jenipapo fruit, annatto, peanuts and rosin.

Body painting is an element of cultural preservation of indigenous knowledge and practices, whether for aesthetics or protection, not only for the Djeoromitxi people. In fact, Mattos (2020) shows that the Wajãpi indigenous people paint themselves with annatto and jenipapo to make themselves look beautiful, but annatto also serves as a repellent against insects, protection against the evil spirits of the forest and to camouflage themselves in the woods.

With regard to the teaching and learning of school mathematics, Benjamim Mopidakeras Suruí (2015), in his course completion paper entitled Difficulties in Teaching and Learning Mathematics at the Noá Suruí Indigenous School, found that 91% of the students liked mathematics and 67% said they had learning difficulties. Among these difficulties is the problem of the Portuguese language, as non-indigenous teachers teach in Portuguese, leading to a poor understanding of the concepts taught.

In the same way, Tupari's (2016) field research aimed to identify the difficulties of learning mathematics in schools in the Rio Branco Indigenous

Land, in the region of Alta Floresta do Oeste, state of Rondônia. In the author's analysis, 100% of the students interviewed liked mathematics. Despite their affinity with the subject, 60% reported difficulties in the teaching and learning process. The mathematical content that students find difficult is Roman numerals, followed by basic operations.

As for the indigenous teachers, when asked if they try to associate the mathematical content of the school with the mathematical knowledge and practices of their ethnic group, 50% said yes and the other 50% said no. Therefore, half of the teachers do not use the students' own knowledge in teaching and learning mathematics in indigenous schools. So, half of the teachers do not use the students' own knowledge to support the teaching and learning of mathematics in indigenous school education. The worst thing is that the students, lacking the maturity to analyze this, blame themselves for the difficulties in learning.

Conclusion

The conception and systematization of school mathematical concepts is the major concern for indigenous teachers, because how can they explain concepts of calculation, numerical sequence, equivalence, comparison, among others, when, in their view, indigenous ancestral knowledge is related to nature and the cosmos? These difficulties encountered by teachers are largely due to various factors, such as multigrade classes and the lack of specific and differentiated teaching material, which ends up leading to decontextualized teaching.

It is necessary for indigenous teachers a pedagogical approach in order to understand the importance of teaching mathematics associated with indigenous knowledge and practices as an instrument in the teaching and learning processes. This can effectively contribute to valuing and rescuing indigenous culture. The knowledge and behaviors that come from

indigenous culture, when shared, enable the culture to continue and are of great value to indigenous school education.

It can be noted that interdisciplinarity contributes as an instrument in the teaching and learning processes, and that the daily practices of indigenous education act as elements of indigenous teaching practice, in order to contribute to a better understanding of the curricular content by the students of indigenous schools.

The academic productions show the importance of indigenous ethnomathematical concepts as elements in indigenous school education. The indigenous academics have tried to record how the concepts presented have been contextualized, for a better understanding of the contents of school mathematics, and how they can be used as teaching material for other indigenous teachers.

Indigenous school education, combined with the community and the indigenous school, using cultural elements as tools in the teaching and learning process, is important for a better understanding of curriculum content. In the same way, the ancestral knowledge of indigenous education can be disseminated through indigenous school education, valuing the culture of the ethnic group.

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