



The professor trainer as an encourager for the ethnomathematics indigenous teachers education

O professor formador como incentivador da formação de professores indígenas etnomatemáticos

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Abstract

The aim of this article is to discuss the role of the professor as a trainer of Mathematics indigenous teachers, acting as a promoter of ethnomathematical thinking in Indigenous Intercultural Licenciature courses. We understand that ethnomathematical thinking can be improved through research as praxis. The investigation promotes the encounter of the mathematical knowledge of the indigenous communities with the Mathematics contents of the curriculum. The ethnomathematical thinking combined with research practice leads to encounters with other areas of knowledge and articulation with their indigenous teachers. It is characterized as a qualitative research involving dialogues with eleven indigenous academics in the area of Natural Sciences and Mathematics. It was possible to observe that, despite the inherence of ethnomathematical thinking in each indigenous academic, it needs to be encouraged by the professor trainer with a view to the ethnomathematics indigenous teachers education.

Keywords: Indigenous School Education; Mathematics Education; Mathematics Indigenous Teachers Education; Ethnomathematical Thinking.

Resumo

O objetivo deste artigo é discutir o papel do professor enquanto formador de professores indígenas de Matemática, atuando como fomentador do pensamento etnomatemático em cursos de Licenciatura Intercultural Indígena. Compreendemos que o pensamento etnomatemático pode ser aprimorado por meio da pesquisa como práxis. A investigação promove o encontro dos saberes matemáticos das comunidades indígenas com os conteúdos de Matemática do currículo. O pensamento etnomatemático aliado à prática de pesquisa provoca o encontro com outras áreas do conhecimento e a articulação com seus professores indígenas. Caracteriza-se como uma pesquisa qualitativa envolvendo diálogos com onze acadêmicos indígenas da área de Ciências da Natureza e Matemática. Foi possível observar que, apesar da inerência do pensamento etnomatemático em cada

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acadêmico indígena, ele precisa ser fomentado pelo professor formador com vistas à formação de professores indígenas etnomatemáticos.

Palavras-chave: Educação Escolar Indígena; Educação Matemática; Formação de Professores Indígenas de Matemática; Pensamento Etnomatemático.

Introduction

As D'Ambrosio (2020a), we understand that the Ethnomathematics Program is constituted by the union of the varied mathematics that are developed through the distinct but interconnected ways, that the social groups or socially identified communities (indigenous, riverside, quilombolas, fishermen, rural workers, among others) have to know and explain the art or techniques of comparing, counting, measuring, inferring, classifying, ordering, writing, describing, modeling, building, among others. Among these techniques or arts, we highlight the mathematics present in school curricula and indigenous mathematics.

In this context, we agree with Mattos and Mattos (2020) in emphasizing that each indigenous people has in their culture what is called in the field of study of the Ethnomathematics Program of Indigenous Mathematics. And each Indigenous Mathematics is constituted by the traditional ways of comparing, evaluating, counting, quantifying, measuring, representing, inferring, classifying, among others, arising from the daily needs of each of these peoples. Thus, as there are several indigenous societies, so we understand that there are several indigenous mathematics. These peculiar ways of mathematizing their daily lives are valid for each indigenous community and, as D'Ambrosio (2020a) points out, the mathematical knowledge developed in cultural contexts is no less or more important than the ways of mathematizing present in the curriculum contents of Mathematics.

For D'Ambrosio (2020a), the encounter between cultures produces conflicts that can be resolved when each individual involved recognizes his culture and respects the culture of the other. In the research field of the Ethnomathematics Program, according to Knijnik, Wanderer, Giongo and Duarte (2012), culture is understood as something dynamic and heterogeneous, that is, not watertight, without mold and as a tense and unstable human production. In this scenario, for Costi and Giongo (2018), just as culture is constantly changing, teaching as it is intertwined with the culture of students is transformed in the course of its process, diverging from something ready, fixed and rigid.

Regarding the teaching of mathematics in indigenous schools, according to D'Ambrosio (2020a, p. 27) "reconciling the need to teach dominant mathematics and at the same time giving recognition to the ethnomathematics of their traditions is the great challenge of indigenous education". In this sense, we understand that Indigenous School Education, in each of its schools in the villages, allows challenging, tense and unstable spaces for discussions and cultural encounters with their differences in the art of mathematics, so that one (Mathematics) does not overlap with others (indigenous mathematics). In this sense, we agree with Ferreira Neto (2018, p. 47-48) by pointing out that

the use of traditional mathematical concepts, inside and outside the classroom, has

been a very effective teaching strategy for understanding the contents. Ethnomathematics comes to consolidate these methodological strategies used by teachers, whether in indigenous, quilombola or rural communities, to facilitate and make knowledge more meaningful for the student.

Ferreira Neto (2018) points out that the teaching of mathematics in indigenous schools, unrelated to the ways of mathematics of indigenous students, possibly causes an abyss between the study of the curriculum contents of mathematics present in indigenous schools and the indigenous mathematics developed in the daily lives of communities indigenous peoples. According to the author, there is no pre-established model for Indigenous School Education, its educational environment is dynamic and moves according to the culture of each of the people who receive their schools in the villages. Indigenous schools are part of the community. And, in turn, communities need to be culturally represented in schools. In this perspective, traditional indigenous knowledge needs to be dialogued with curricular knowledge, with a view to being allocated to the curriculum of Indigenous School Education and discussed in each indigenous school.

Corroborating this statement, Oliveira (2018), highlights that Ethnomathematics is an epistemological lens that can instigate indigenous teachers in the area of Natural Sciences and Mathematics to use the space provided by Indigenous School Education to, possibly, rescue traditional mathematical knowledge of their community and promote the emergence of the context (s) of this knowledge with the mathematical content of the school curriculum. “[...] we recognize that Ethnomathematics can provide a theoretical basis for teachers to think, reflect, plan and develop pedagogical practices that mark the place of traditional knowledge in school education” (Oliveira, 2018, p. 179). This author also points out that the indigenous mathematics teacher can act in the process of autonomy of his people by promoting the dialogue between the knowledge and activities of the community with knowledge and activities from outside, as well as promoting the elevation of his people's self-esteem, reinforcing their origins and validating their traditional knowledge.

With regard to thinking, according to Clareto (2009), ethnomathematical thinking meets the educational process that enables cultural valorization, which acts naturally, which provokes reflections and leads to dynamic and flexible planning. According to the author, this occurs both in the field of study and construction of the Mathematics curriculum, as well as in the elaboration of the activities of the classes with a view to the encounter between the contents of Mathematics and the mathematical knowledge of the students involved. In this perspective, we understand that the development and the probable improvement of ethnomathematical thinking, on the part of each indigenous academic in the area of Natural Sciences and Mathematics, is fundamental for their future performance in indigenous schools.

Corroborating the debate, Mattos (2018) points out that the teaching work happens through mutual exchanges between each teacher and his students. During the dynamic educational process, the teacher teaches and learns, as well as the students involved learn and teach. The professor trainer of indigenous teachers is generally not indigenous and he needs

to act as an ethnomathematics educator, as highlighted (Barros, Xavier & Fialho, 2018), that is, an educator who values the cultural identity of students and promotes links between the mathematical knowledge and traditional knowledge of those involved in the teaching process. We emphasize that the debate proposed in this research can be extended to all teacher training courses that teach mathematics.

In this article, we intend to analyze the role of the professor who trains indigenous teachers in the area of Natural Sciences and Mathematics, which for us needs to act as a promoter of ethnomathematical thinking. In other words, it is one that seeks to sensitize each indigenous academic to reflect on the possibility of inserting the traditional knowledge of those involved in the educational process, in their research, in the school curriculum and in their classes. After all, we understand that the indigenous Mathematics teacher, instigated by his studies in Ethnomathematics and, the possible improvement of his ethnomathematical thinking, is the one who needs to investigate and enable cultural links between the curricular contents of Mathematics and the peculiar ways of mathematizing, present in each indigenous community. Thus, we agree with D'Ambrosio (2020b) when instigating the probable formation of ethnomathematics teachers, in this research, ethnomathematics indigenous teachers.

We characterize this investigation as qualitative, because according to D'Ambrosio (2013), qualitative research seeks to understand and argue what is being investigated. It seeks to lead the researcher to interpret the qualitative data collected from the participants' speeches, both those described in documents and those collected in the natural environment of the individuals participating in the research. Qualitative research "deals with and pays attention to people and their ideas, seeks to make sense of discourses and narratives that would be silent" (D'Ambrosio, 2013, p. 21).

The collection took place in the development of two meetings of two hours each, the first in the afternoon of 11/08/2019 and the second in the morning of 11/09/2019. The meetings were held at an indigenous school and counted with the participation of indigenous academics enrolled in the fifth semester of a Brazilian Indigenous Intercultural Degree (11 members), who chose the area of Natural Sciences and Mathematics for their training and took the subjects course Ethnomathematics. Below, we present some aspects of Ethnomathematics in the formation of indigenous mathematics teachers.

The ethnomathematical thinking in the formation of indigenous ethnomathematics teachers

Regarding the teaching of Mathematics within the scope of Indigenous School Education, D'Ambrosio (2012), points out that speaking of Mathematics in the indigenous scenario sounds like something that comes from outside the community, mathematical knowledge represents what is constructed by the dominant and is imposed at school. In this educational context, for both Mattos and Ferreira Neto (2019) and Oliveira (2020), the training of indigenous teachers to teach mathematics in indigenous schools, involving studies

in the field of Ethnomathematics, probably favors the constitution of links between mathematical knowledge and traditional knowledge humanizing the mathematics teaching process.

Corroborating the debate, according to (Knijnik et al., 2012), Ethnomathematics is a field of research in the field of Mathematics Education in constant expansion, its studies cover other areas of knowledge, with emphasis on Mathematics, Science of Nature (Biology, Physics, and Chemistry) in addition to Language, History, Philosophy, Arts, Anthropology and Sociology. According to D'Ambrosio (2020b), Ethnomathematics acts as a research program, the Ethnomathematics Program, which brings with it humanistic think in the development of mathematical knowledge. In other words, this knowledge is a human construction and is present in all communities. The ethnomathematical thinking of each researcher is improved through his investigations within the scope of the Ethnomathematics Program.

For Araujo (2016), the Ethnomathematics Program does not intend to replace Mathematics, but to promote dialogue with the mathematical knowledge of those involved in a process of teaching Mathematics. And in this dialogical relationship between the two mathematics, the curricular and that of the students, one learns from the other, a single way of thinking mathematically is valued and not privileged (Araujo, 2016). The main objective of research in this Program is to seek to make sense of the ways of knowing and doing in all cultures, in addition to recognizing how and why human groups, socially identified, carry out their mathematical practices (observe, evaluate, compare, classify, organize, measure, quantify and infer, that is, draw conclusions). And, among them, we highlight the indigenous mathematics developed by each ethnic group.

When we talk about indigenous mathematics, we are referring to the cognitive aspects that each indigenous people build, based on the worldview of each indigenous individual and, consequently, of the indigenous community to which they belong. And each indigenous people has their interpretation, their stories, their myths, their rituals, beliefs, their interpersonal relationships, their ways of interacting with other communities and with nature or in their habitat.

The Ethnomathematics Program, investigates and seeks to understand in this complexity the aspects (classify, measure, among others) of the cultural knowledge of each people in its focus of study. The educational space provided by Indigenous School Education, on the other hand, enables the indigenous Mathematics teacher of each community, to intertwine these aspects with the curricular contents of Mathematics. Thus, we understand that the indigenous mathematics teacher, through his ethnomathematical thinking, researches, plans and executes these interlaces with the participation of his indigenous students.

According to Mattos (2020, p. 29), the Ethnomathematics Program

it is a program that tries to solve some teaching and learning problems that have dragged on for a long time, that perpetuate and disseminate aspects that contain controversies and that generate mistakes regarding the different mathematical

manifestations that exist in the most varied socio-cultural groups around the world.

The Ethnomathematics Program is dynamic in its investigations, it considers the historical and cultural characteristics of what is being researched from its perspective. Its pedagogical action has a strong cultural appreciation of the participants in the research, possibly bringing empathy to the act of teaching with a possible positive influence on the learning of the participants, in the course of each teaching and learning process of Mathematics content. In their theoretical contribution, those involved have a voice and are invited to cultural dialogue bringing the ways of mathematizing, present in the daily lives of those surveyed, contextualizing, for example, aspects of indigenous mathematics in the educational process of Mathematics in indigenous schools.

We agree with D'Ambrosio (2020b) in emphasizing that it is necessary to train ethnomathematics teachers, that is, that they understand that mathematics are undertakings of human knowledge that have been improving since the first human beings and in all cultures on the planet. The ethnomathematics teacher seeks to understand the nature of each of the socially identified mathematics, so he conducts research with the participation of his students promoting the intertwining of the mathematical knowledge of these students with the Mathematics content of the school curriculum. Thus, we understand that the training of indigenous ethnomathematics teachers goes through the understanding of indigenous mathematics, represented by each indigenous academic involved in the educational process, as mathematical knowledge that asks to be discussed in indigenous schools.

Thus, being an ethnomathematics teacher demands to be a researcher teacher. And research must involve students, so these students need to speak and be heard, they have to participate in their training process, both in the academic context of teacher training and in the school setting. We understand that in the first educational context, it is mainly up to the professor trainer to instigate that academics develop the habit of conducting research and, in the second, the ethnomathematics teachers, when acting, seek to bring the research dynamics into their praxis.

For D'Ambrosio (2010), research is the link between theory and practice. The teacher knows many things, especially in relation to his area of training, but he does not know everything. "He knows much less about many things than his students. It is important to make room for the students' knowledge to manifest" (p. 85). Thus, we defend that the perspective of giving voice to indigenous scholars is fundamental on the part of the professor who trains indigenous teachers. In other words, in the course of the dialogues, it is likely that both the professor trainer and each academic involved will improve his ethnomathematical thinking.

According to Álvarez, Oliveras and Oliveras (2017), the teaching of Mathematics from the perspective of Ethnomathematics enables the participation and contribution of students by bringing their ethnomathematics practices to the classroom, positioning the student as a producer of knowledge and not only as a mere spectator of the teaching process. In this context, in relation to the training of indigenous teachers to teach mathematics, the

professor trainer seeks to know more and more about the mathematical knowledge of those involved, as well as each indigenous academic aims to learn more and more about mathematics in dialogue with the professor.

Corroborating with the debate, according to Arouca and Cauty (2017), the mathematical knowledge of the indigenous people needs to be systematized from the perspective of the community involved and trying to avoid possible difficulties that may arise due to the fact that the professor trainer is not from the community in question. The joint work of professors and students promotes the intertwining of traditional mathematical knowledge with the contents of Mathematics present in the curricula of the Indigenous Intercultural Degree and Indigenous School Education. However, as Arouca and Cauty (2017) point out, the relationship between traditional mathematical knowledge and mathematical knowledge, both in the classroom and in the school curriculum, needs to happen without imposing the second to systematize the first.

The ethnomathematical thinking leads the individual to want to do more research, to want to share these investigations, to respect and want to know what is different. It provokes thinking in the dialogue between what is already known with what one seeks to know. It allows the individual to see and feel mathematically inserted in their community, in their natural environment (D'Ambrosio, 2020a). And it goes further, as D'Ambrosio (2020b) points out, instigating the individual to want to know other realities, other environments, other people, other mathematics and other cultures. For that, we need to train ethnomathematics teachers, so that they feel and see themselves ethnomathematically inserted in their communities and within the scope of the Ethnomathematics Program.

Methodological procedures

The present research is characterized as qualitative, having as scenario of debate two meetings of two hours each, the first being held in the afternoon of 11/08/2019 and the second in the morning of 11/09/2019. These meetings took place in an indigenous school with the participation of indigenous scholars from the fifth semester of a Brazilian Indigenous Intercultural Degree (eleven members), who chose the area of Natural Sciences and Mathematics for their initial training.

The context of the meetings involves discussions about what Mathematics is and its possible anthropological focus, as well as what comes to be Ethnomathematics, highlighting its studies, which among other proposals, seek to promote the link between Mathematics present in the curricula of indigenous schools with the knowledge mathematicians from culturally identified social groups, with emphasis on indigenous peoples. In these meetings, we intend to instigate each participating indigenous academic to develop the improvement of their ethnomathematical thinking, with a view to seeing and feeling ethnomathematically inserted in their community and seeking to bring research into their praxis.

At the first meeting, we made the presentation of the planned theme, causing speeches and questions from academics, but we did not have much return to these provocations. In this

initial process, we talk more than we hear about 90 minutes. At the end of this presentation, we purposely asked each indigenous scholar for a written answer to the following question: For you, what is Ethnomathematics? In addition, we request a brief comment on the first meeting.

Then, having these answers, we read what they wrote. Our intention is to conduct the second meeting based on what they answered. In other words, we consider what they wrote as elements to instigate the discussions of the next debate scheduled for the morning of the following day. In the second meeting, we intend to listen more than talk. Then, through the cell phone, we took pictures of some parts of the responses and comments, to put them in the presentation and, based on these textual samples, from the academics, to encourage the debate of the second meeting.

On the other hand, we noticed that the classroom walls have indigenous paintings, as well as the spaces of every indigenous school. We decided to bring some pictures of these paintings to add to the discussions. In addition, we took advantage of the fact that one of the academics proposed that we discuss the teaching of some mathematical content from the headdress he was wearing. Then, in the final part of the second meeting, we discussed with them the possibility of teaching how to calculate the price of selling a headdress, since the local indigenous people sell these headdresses to tourists who visit the region. The following is an overview of the results of the discussions at the second meeting.

An overview of the discussions

Regarding the comments of the first meeting, of the eleven participating indigenous scholars, eight responded that they found the dynamics used in the presentation very tiring. We agree with D'Ambrosio (2020b) when stressing that the theoretical explanation on the part of the teacher should not take more than thirty minutes, except for some exceptions in which the theme of the presentation is complex, demanding more time for explanation. Furthermore, as we have already pointed out, it is necessary to give a voice to those who are listening, to provoke debate.

We started the discussions of the second meeting, bringing samples of answers to the question about what is Ethnomathematics? In general, these answers point to Ethnomathematics as a field of study of mathematics developed in different contexts. Of the eleven academics, we obtained eight responses, of which we highlight four, as shown in Figure 1, as they were the ones that most encourage discussions.

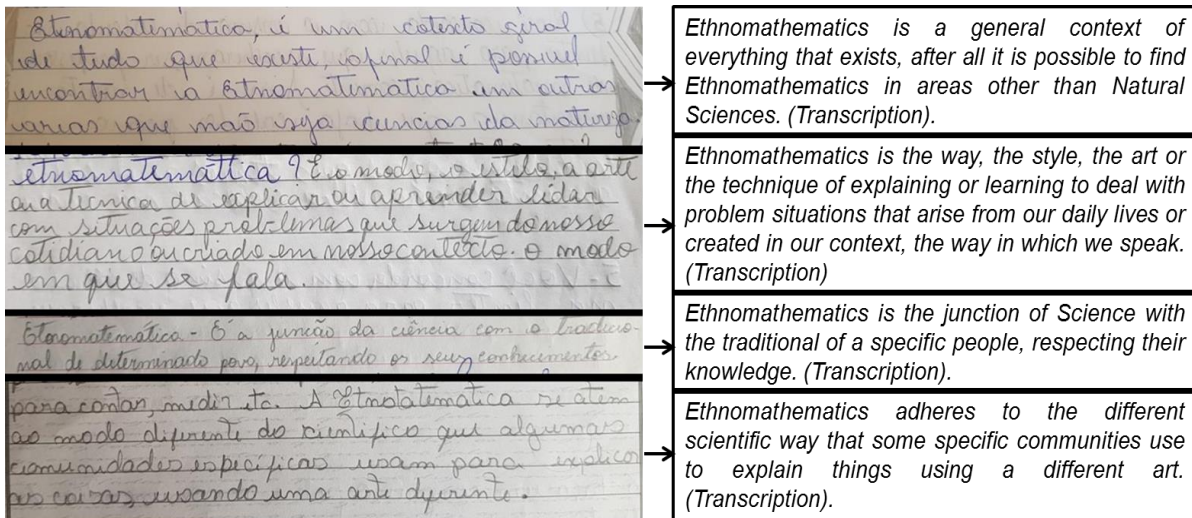


Figure 1 - Samples of the responses of the academics who encourage the discussions

Source: The authors.

The first response in Figure 1 fostered the discussion on Ethnomathematics, in the sense that, of the eleven participating academics, initially, five did not agree that Ethnomathematics is present in other areas of knowledge, in addition to those that make up the training area of Natural Sciences and Mathematics. In fact, in relation to the areas of knowledge where Mathematics is involved, Ethnomathematics is present. This is the case with Physics, Biology and Chemistry, for example, which are part of the training area in Natural Sciences and Mathematics.

However, we emphasize with academics that, according to D'Ambrosio (2020a), Ethnomathematics has close relations with History, Philosophy, Sociology, Anthropology, Arts and Language. This is in line with what Mattos (2020, p. 29) says when he emphasizes that the Ethnomathematics Program “[...] does not close, but enables possibilities to promote interdisciplinarity, combining the most different areas of knowledge. It is a program with a holistic vision that seeks to break the imaginary barriers that exist between disciplines”. So it is possible to find Ethnomathematics in addition to the area of Natural Sciences and Mathematics. Thus, it opens up the possibility of interdisciplinary research in partnership with indigenous teachers from other areas of knowledge, having Ethnomathematics itself as a link and as target audience students from indigenous schools common to the teachers involved.

The second response in Figure 1 provoked discussions regarding its end, as the academic who answered highlighted that Ethnomathematics seeks to explain problem situations created in the context of an indigenous community, including with regard to the way they speak. In the discussions, academics point out that indigenous mathematics worked in their communities is developed through speech, as is the case with their mother tongues. In other words, just as there is no original writing for the Native Language, there is no proper writing for Indigenous Mathematics. The two go together and are transmitted orally from generation to generation, through parents, grandparents and elders. Whether telling stories,

simply talking or performing daily activities. Here, we emphasize with academics the need to bring the elders from the community to dialogue with the students, or to lead them to them.

Corroborating the discussion, Santos (2020) in his research with individuals of the Tupari ethnic group, located in the State of Rondônia in Brazil, points out that even before their first contacts, the Tupari already had their own pedagogies, cultivated plants and harvested, carried out the construction from malocas and utensils for hunting and fishing, they understood the seasons with their climatic changes and periods of rain and drought. For Santos (2020), the indigenous mathematics of a people develops mainly through orality. “The Tupari language in the Villages I’ve been to is very strong and as a result the language is a traditional structure for doing and thinking mathematically” (p. 157). As highlighted by D’Ambrosio (2020a), mathematical knowledge and the need for communication have always been linked to our needs for survival and transcendence, which, among other things, leads to the development of different languages and different mathematics.

The third answer in Figure 1 reinforces the question of respect for traditional knowledge. All scholars asked to speak to emphasize the need for respect and cultural appreciation and concluded that it is up to indigenous teachers who work in indigenous schools, not only in the area of Natural Sciences and Mathematics, to discuss this with indigenous students in their classes and with the community. This is one of the assumptions for the formation of indigenous teachers.

Thus, we agree with Monteiro (2018) when stressing that, within the scope of Indigenous School Education, the traditional knowledge from the community where the indigenous school is inserted, should be presented in a systematic way seeking to strengthen and expand cultural practices through students indigenous peoples. Here, we extend this need to the process of training indigenous teachers. After all, we understand that when the indigenous teacher researches, discusses, speaks and listens, points out solutions, promotes reflections, plans and executes activities, allows a voice for his students, among others; all of these actions are representative of their people.

In this sense, everything that every indigenous teacher does in indigenous schools, even when teaching Mathematics content, sounds like something that comes from within the community. In contrast, when a non-indigenous Mathematics teacher gives Mathematics classes within the scope of Indigenous School Education, no matter how hard that outside teacher tries, study the culture of the community involved, bring mathematical knowledge to dialogue with the Mathematics content, it may even enable success in the proposed teaching and learning process, however it will not bring up the question of representativeness that only an indigenous ethnic teacher can provide to his community and, especially, to students in indigenous schools.

With regard to the investigations carried out in the Ethnomathematics Program, this discussion is in line with what D’Ambrosio (2020b) says when stressing that it is necessary to go beyond the training of mathematics teachers. It is necessary to train ethnomathematics teachers and for that, the role of the professor trainer, as an ethnomathematics educator, is to

instigate the improvement of ethnomathematics in the cognitive of each student, here in each indigenous academic in the area of Natural Sciences and Mathematics. And that, either in initial training as in the case of this research or in the continuous training of indigenous teachers. For D'Ambrosio (2020a), every mathematics teacher needs to have an ethnomathematics attitude. Thus, we understand that every teacher who is a teacher of Mathematics must have the attitude of seeing himself and acting as an ethnomathematics educator.

Regarding the fourth answer in Figure 1, we provoke the debate by asking indigenous scholars what is the different art used to explain things? For example, in the classroom, according to Figure 2, some indigenous drawings are represented which, when a teacher who is not an indigenous person observes them, can identify in them some possible representations of geometric figures such as the triangle and the rectangle. Now, when the indigenous person looks at these drawings or when he draws them himself, what does he see? What does he think? What does he feel? What message does he want to convey?



Figure 2 - The paintings in the meeting classroom
Source: The authors.

Everyone set out to answer. One of the academics started by informing us that the painting drawn in the classroom represents the figure of the male, so much so that on the back wall of the room we see, according to the image in Figure 2, a representation of a male Indian. For the representation of the female sex, the circle is drawn in place of the rectangle. The design for the male is simpler, as the man has simpler habits, for example, in the way of dressing. The drawing for the female is more complex, has more lines, the woman is a more detailed human being, for example, in the way of dressing. Another academic points out that body paintings also have this representativeness, but if an indigenous male wishes to honor women he can make paintings that are understood to be female and vice versa. So, this is the message present in these paintings.

In the research by Suruí and Leite (2018), involving the traditional knowledge of the Paiter people, which is located between the States of Rondônia and Mato Grosso, the authors emphasize that the traditional painting of this ethnic group has geometric shapes that are not restricted to presenting only such shapes or aiming at ornamentation. The messages of the

Paiteir paintings go further, crossing the spiritual dimension and the political dimension, because in their cultural context, there are specific paintings for some deities, as well as drawings and paintings that adorn specific artifacts for the exclusive use of the Paiteir leaders. So, where the mathematics teacher, who is not an indigenous person, observes geometric figures in the drawings and paintings of an ethnic group, the ethnomathematics teacher, through his ethnomathematical thinking, investigates the culture of the ethnic group involved talking with the indigenous ethnic group, to go beyond of your mathematical vision. And in this research process, his ethnomathematical thinking is probably improved.

In this sense, we dialogue with indigenous scholars that each indigenous community has its cultural particularities, which need to be respected and understood by the ethnomathematics teacher who seeks to interweave traditional knowledge in his Mathematics classes. The teacher who sees himself as an ethnomathematics, is always doing research, especially with his students as a participating audience. Whether he is an indigenous or non-indigenous teacher. And as a research developer he must disseminate them to share his results that can lead to reflection, as well as instigate the training of other ethnomathematics teachers.

Dialogue with other areas of knowledge from the headdress

On the way to the final part of the second meeting, one of the academics proposed to discuss the teaching of Mathematics content from the indigenous headdress. As we have already said, this suggestion was described in one of the responses we collected at the first meeting. In this sense, we had already planned how to possibly foster this discussion.

According to Mattos e Ferreira Neto (2019), the importance of using, for example, an indigenous artifact in the teaching and learning process of Mathematics does not reside only in the didactic use of the artifact, but mainly when considering this artifact as a mind-fact, that is, it is representative for his people, has history and cultural knowledge inherent to him. In this sense, the view of a non-indigenous mathematics teacher is different from the view of an indigenous mathematics teacher for the artifact in question. However, we understand that the perspective of the ethnomathematics teacher gains in respect, cultural appreciation, representativeness to indigenous students and opens possibilities for research and dialogue with other areas of knowledge, as well as relationships with other perspectives of the same and other indigenous ethnicities.

We begin by arguing that for us the headdress initially presents the idea of symmetry in relation to the size and color distribution of its feathers. In addition, we emphasize that we can work on counting these penalties involving indigenous students in the process of making the headdress. We emphasize that these headdresses are made by the local indigenous people, to be sold in the local indigenous trade to tourists visiting the region. In Figure 3 we show the academic headdress.

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Figure 3 - The headdress of the academic involved in the discussions
Source: The authors.

Instigating the debate, we asked participating academics how the sale price of each headdress is established or calculated. The scholar who proposed the discussion said that it depends on the size of the headdress, as there are three different sizes, one smaller for children, another intermediate for women and the larger one that suits men. The larger, the more material is used and takes more time to be ready, making the headdress more expensive. So, considering PV as the selling price, PC as the cost price and L as the profit, we can write the following relationship: $PV = PC + L$.

We spoke with indigenous scholars that the PC is made up of the total expenses with the material used to make each headdress. Basically the expense of buying string and feathers. One of the academics pointed out that some feathers are bought from other peoples, mainly the three largest ones that come from birds that rarely appear in their territory. We highlight that the central pen represents the oldest village (mother village) of the ethnic group of the participating academics. The other two larger feathers, one represents the birth village of the headdresses and the other represents the largest ethnic village.

Regarding the string, another academic who makes headdresses contextualizes that on average one roll of string is enough to make about twenty headdresses for men. So we inferred from the discussion that with this information it would already be possible to calculate, approximately, the cost price for each headdress of the largest, and we can continue investigating to also construct the cost price of the other smaller headdresses. And the profit?

According to the academic who brought the headdress, the profit is the value that is earned from the sale of each headdress. In other words, we only need to predict the cost price of the material involved in making the headdress and discount the sale price ($L = PV - PC$).

The calculation of the L itself is simple. Provoking the discussion, we answer that yes if we look at the monetary value, but if we think with Ethnomathematics, that is, through ethnomathematical thinking, we can understand profit as the value of the work of the artisan who made each headdress, and being made of each headdress is unique. This value of work, of the culture present in each headdress is transformed into income, in this case profit, which is used to supply some needs of the community.

We dialogue with academics that, for Bello (2010), the pedagogical proposal of research in Ethnomathematics, develops in educational contexts of cultural diversity, proposing a path for the formation of research professors. For us, ethnomathematics teachers, who promote the dialogue between the knowledge arising from these diversities, whether they are themselves from one or more cultural contexts of those involved in the educational process, teachers and students. And, even, those that are organized and systematized in other subjects, going to meet other areas foreseen in the school curriculum, seeking other knowledge that are related around a common theme. Looking beyond mathematical knowledge.

So, we discussed with the participating academics that, initially, we need to think (ethnomathematical thinking) about the possibility that in the educational process developed from the headdress, Mathematics is not alone. The ethnomathematics teacher will seek to dialogue with teachers in other areas, for example: the indigenous teacher of Biology can contribute talking about the species of birds that produce these feathers by intertwining their scientific names with their names in the Mother Language, the indigenous teacher of Chemistry can debate the process of making string and dyeing the original feathers to make colorful headdresses, the indigenous teacher of History can instigate research into the traditional history of the headdress, the indigenous teacher of Geography can discuss with the students about the regions where these birds live, the indigenous teacher of Anthropology can provoke dialogue by introducing the other indigenous peoples who sell these feathers to the community, the indigenous teacher of Sociology can debate on the social issue of the sale of artifacts, the indigenous teacher of Arts can work on making the headdress even bringing an indigenous artisan to contextualize, the indigenous teacher of Language can contribute by discussing in the Mother Language and in the Portuguese Language the counting of sentences, among other possibilities.

In this context, the headdress can be understood as the theme that generates educational discussions, involving a range of indigenous teachers in joint work, seeking the possibility of promoting the construction of knowledge in their students. Research is the link between theory and practice for all areas of knowledge involved in the process. And in the case of the indigenous ethnomathematics teacher, his ethnomathematical thinking guides him through each dynamic and complex process of teaching and learning mathematics. In this action, mathematical thinking does not stop happening, after all it is fundamental in the educational process. It gains plurality, mathematics, it expands and expands as it transforms into ethnomathematical thinking.

In addition, we instigated a brief discussion on the work of Mattos (2018) that was developed with eleven indigenous teachers of the Wajãpi ethnic group present in the State of Amapá. According to the author, Wajãpi teachers do not only work in the classroom. They lead their students into the forest to learn about the names of trees, names of rivers and places, names of animals, among others. In other words, Wajãpi teachers with this educational dynamic act as an extension of the parents of these students. According to Mattos (2018), Wajãpi teachers report that with these actions of leaving the classroom it allows the approximation of the curricular contents with the elements of the local indigenous culture, they understand it as a necessary action to enable contextualization with non-indigenous knowledge.

After the end of the second meeting, five participating academics came to us to indicate some texts on the Ethnomathematics Program and ethnomathematical thinking. So we proceeded with the indications highlighting some works published by indigenous Mathematics teachers, who carry out research with their indigenous students, involving the indigenous knowledge of their ethnic groups with curriculum content in Mathematics. We emphasize that among these five academics who came to us, two of them had not answered the question we asked in the first meeting.

Final considerations

This research was carried out within the scope of Mathematical Education, especially in the field of study of the Ethnomathematics Program. We agree with (Santos, Bernardi & Nascimento, 2020), by emphasizing that the theoretical contributions of Ethnomathematics in the formation of indigenous teachers to teach Mathematics in indigenous schools, enables the construction of intercultural links between the traditional mathematical knowledge of the academics with the present mathematical knowledge in the curriculum. For these authors, the praxis of the professor trainer from the perspective of Ethnomathematics reinforces the self-esteem of indigenous scholars and intensifies the pride of belonging to their culture and community. In Figure 4 we have the testimony of one of the eleven participants in this research, which is in line with what Santos, Bernardi & Nascimento (2020) emphasize.

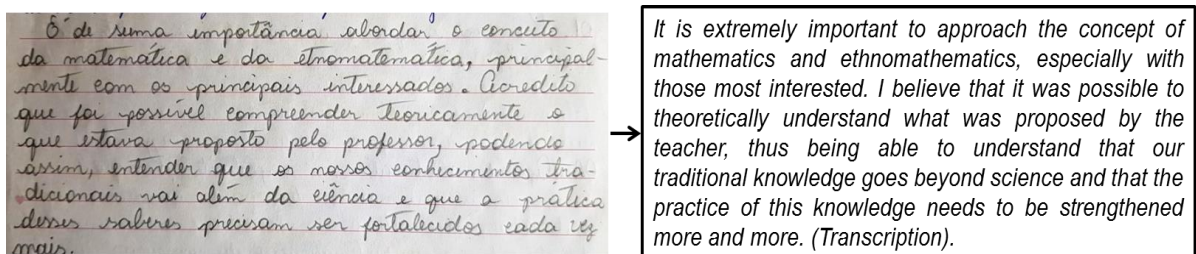


Figure 4 - Testimony of an indigenous academic

Source: The authors.

Corroborating the testimony described in Figure 4, according to Voltolini and Kaiber (2017, p. 637), “the valorization of the knowledge that circulates in the Communities, the traditions that span the generations, is a path that can contribute to the students' learning and

strengthening the culture and identity of the indigenous people [...]”. The authors also emphasize that the knowledge allocated to the school curriculum when they are intertwined with traditional knowledge gains meaning and can be used by the community.

We believe that one of the main roles of the professor who trains indigenous teachers in the area of Natural Sciences and Mathematics is to promote the improvement of ethnomathematical thinking that is already inherent in indigenous scholars. Therefore, the professor trainer needs to see himself and act as an ethnomathematics educator. For us, this promotion is done mainly with the insertion of research in educational praxis, as pointed out (D'Ambrosio, 2010), that is, it is necessary to develop the habit or culture of research in the formation of indigenous teachers so that they probably replicate this habit in indigenous schools with their students.

Investigation to seek to understand mathematics through dialogue between different ways of mathematizing. Research to promote creative insubordination and communication with other areas of knowledge. And so, create the possibility to train indigenous ethnomathematics teachers who feel and see themselves ethnomathematically inserted in their communities. And that after each research carried out with its indigenous students, in partnership with other teachers and beyond the classroom, they are no longer the same, both ethnomathematics teachers and students.

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