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# At the crossroads of ethnomathematics and Brazilian carnival: A study with samba schools

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*We present a study that aimed to identify ethnomathematical manifestations produced by artists from two samba schools in Florianopolis, Brazil: the associations “Os Protegidos da Princesa” and “Embaixada Copa Lord”, in order to recognize both as educational spaces, where (mathematical) practices are developed. The study was underpinned by the Ethnomathematics Program, including fieldwork, participant observation, semi-structured interviews, and audio-visual recordings. Educational processes through curiosity and observation are highlighted, as well as techniques to cope with the demands of the carnival parade. We shed light on the epistemological diversity and the radical lines that try to make these forms of knowing and living invisible and non-existent.*

*Keywords: Ethnomathematics, popular education, educational processes, diversity, decolonization.*

## Establishing the study territory

The Ethnomathematics Program is a Lakatosian research programme on the history and philosophy of mathematics that includes studies in ethnomathematics and its political and pedagogical implications. In the 1970s, the Brazilian mathematics educator Ubiratan D’Ambrosio was the first to coin the term “ethnomathematics”, which emerged as an analysis of mathematical practices in diverse cultural environments. Although the name suggests an emphasis on mathematics, or an ethnical-mathematics, “it is a study of the cultural evolution of mankind in its widest sense, starting from the cultural dynamics that can be seen in mathematical manifestations” (D’Ambrosio, 2005, p. 3).

Based on an etymological explanation, these studies can be summarized as a theoretical reflection on the *tics* (modes, styles, arts, and techniques) of *mathema* (explaining, learning, knowing, coping with) in distinct *ethnos* (social and cultural environment). Therefore, ethnomathematics is tightly intertwined with education, as it means knowing and recognizing the set of techniques used by different cultural groups to solve problems and understand the world around them.

The Program is often used in the Global South in reference to Popular Education, as in Knijnik’s (2004) study with the Brazilian Landless Workers Movement. Based on a 10-year study, her findings have become a key aspect of understanding mathematical knowledge from a political perspective, discussing the importance of listening, and learning from social movements. Other scholars, such as Araújo (2018) in Colombia and Prahmana (2022) in Indonesia, have focused on a contextualized mathematics education that respects local knowledge. In recent years, researchers have also become increasingly interested in the contributions of ethnomathematics to anti-racist education, incorporating Indigenous, African, and Afrodiasporic knowledge into the curriculum from an ethnomathematical perspective (Rosa & Oliveira, 2020). At the margin of Europe, Bjarnadóttir (2016) has carried out a study on the Viking calendar, pointing out how the pagan language and culture are preserved by the Icelandic mathematical heritage.

Moreover, the Program concerns educational practices in general, presenting concepts of cognition and epistemology of (mathematical) knowledge. François (2012) argues that ethnomathematics has gained a prominent role within Western European curricula as well, impacting the philosophy of mathematics education by providing elements to explore its various aspects of cultural diversity.

Within the scope of the Ethnomathematics Program, this paper is organized into four parts that provide an overview of an ongoing study with Brazilian samba schools. The choice of samba schools as a field of study was motivated by the fact that they offer a rich and diverse set of mathematical practices, linked to cultural and historical aspects of Brazilian society. In the first section, we establish the research territory and present some fundamental ideas underlying ethnomathematics. The next section, “Context and design of the study”, outlines the key principles behind our methodological approach and introduces the field of study. The third part, “Results and discussion”, presents and discusses some of our findings, focusing on their cognitive dimension. In the section “Cross considerations”, we shed light on important political aspects of the research. An in-depth analysis of curricular mathematical content is beyond the scope of this article.

### **Context and design of the study**

The theoretical and methodological framework of this study is based on the Ethnomathematics Program, with a particular focus on its cognitive and political dimensions. Rosa and Orey (2016) describe the Program as having six dimensions – conceptual, cognitive, educational, epistemological, historical, and political – that support its holistic approach to mathematics. By recognizing the practices developed in different sociocultural contexts, the Program offers a broad view of mathematics. The cognitive dimension involves human abilities such as comparison, classification, quantification, measurement, explanation, generalization, deduction, and evaluation. The political dimension focuses on decolonization and the recognition of knowledge produced beyond Western/academic mathematics.

In this context, we conducted research in collaboration with two samba schools located in Florianópolis, state of Santa Catarina, southern Brazil: “Os Protegidos da Princesa” and “Embaixada Copa Lord” (Fernandes, 2020). Brazilian samba schools emerged in the 1920s as a popular response to institutional racism during a historical period when the State apparatus persecuted the black population and its various manifestations. As an expression of the Brazilian Black Movement, they are educational spaces that produce emancipatory knowledge (Gomes, 2017) and teach the public about Brazilian black history and culture, along with their struggles. To achieve this, they annually organize carnival parades, which tell stories through special floats, costumes, props, and samba-plot.

This study sought to identify ethnomathematical narratives and practices produced by carnival artists, highlighting educational processes performed during the creation and production of the parade artifacts. Therefore, we aimed to analyse cognitive aspects of samba schools’ activities, which often involve mathematical concepts and operations, such as geometry, proportionality, and measurement. Besides knowing and identifying the school’s techniques, we pose why the (mathematical) knowledge constructed in these spaces is considered irrelevant.

Fieldwork was undertaken over a 2-month period, during the preparation of the 2019 carnival parade. In this period, the researcher acted as a volunteer in two associations and did the same work as the

participants, observing, analysing, and describing their social reality with care and respect. Both associations are in a region called “Maciço do Morro da Cruz” (Morro da Cruz Mountain Range), where 16 communities are located, including “Mocotó” and “Monte Serrat”, where “Protegidos” and “Copa Lord” are based.

Data come primarily from participant observation and conversations with 12 participants responsible for producing carnival floats, costumes, and props. The group was composed of 4 black women, 2 white women, 2 indigenous men, and 4 white men, with varying levels of education – from incomplete elementary education to a graduate degree. Additional data were gathered through three semi-structured interviews: one conducted before starting fieldwork with i) the Carnival Float Designer of “Protegidos”, a white male Professor, and two after the parade, with ii) the Costumes Director of “Copa Lord”, a graduate black woman, and iii) the Props Director of “Protegidos”, an indigenous man who did not finish high school.

The study received approval from the ethics committee of the Federal University of Santa Catarina, and all participants signed a consent form. The conversations and interviews were recorded and transcribed, resulting in a logbook containing photographs, descriptions of the environments, situations, and participants, in addition to the original sketches of the artifacts. In the following years, the researcher continued to work as a volunteer in the associations, even after the end of fieldwork.

## Results and discussion

The educational relationship between the artists is evident in a story told by Mestre Louro, blacksmith and head of the “Os Protegidos da Princesa” team. In this tale, Louro explains why people called him “Mestre”, which means “Master”, revealing a profound bond of knowledge exchange between them:

Mestre Louro: Eu tenho uma história muito boa no carnaval aqui. Eles costumam me chamar de Mestre Louro, porque eu pego as pessoas assim e costume ensinar assim. Aí a gente não tem essa arrogância de ficar com o que a gente aprende para si mesmo, sabe? É uma coisa que a gente tem que passar para as pessoas.  
*I have a wonderful history with the carnival. In Florianopolis, I'm known as Mestre (“Master”) Louro, because I love to teach everyone who visits my workstation. This way, there isn't that selfishness of keeping what we learn to ourselves. It's something we must pass on to others.*

Observation is a central aspect of the educational processes developed in samba schools – which was evident in many of the subjects’ narratives, especially in the following conversation with Anna Paula, an artist from the same association:

Researcher: Como você aprendeu a trabalhar com tecidos e costura?  
*How did you learn to work with fabric and sewing?*

Anna Paula: Eu acho que foi coisas da gente aprender mesmo da vida. Porque essas coisas que eu sei fazer agora foi tudo olhando, direitinho, como se fazia, como se cortava, como faz a metragem. Eu aprendi muito com o Hudson! [...] Eu fui muito, eu sempre fui curioso. Então sempre tive curiosidade de aprender esse tipo de coisa.  
*I think these skills were things I learned from life. Because these things that I know how to do now came from always carefully observing how it was done, how it was cut, how it was measured. I learned a lot from my colleague, Hudson! [...] I've always been very curious to learn these things.*

This dimension of curiosity present in Anna Paula's narrative is classified by Paulo Freire (1998) as a vital phenomenon inherent to the learning process. On another occasion, her colleague Hudson says that he started to sew "out of stubbornness" to make his own carnival costumes. This way, he also approaches the dimension of curiosity generated by a knowing/doing that he did not have. Both cases reveal educational processes through curiosity, observation, imitation, and repetition. Therefore, techniques and methods are shared to cope with their specific social practices. With Paulo Freire, we can support our notion that this is due to "the creative force of the learning process, which encompasses comparison, repetition, observation, indomitable doubt, and curiosity not easily satisfied" (Freire, 1998, p. 12).

In some decorating activities, such as making props, measurement accuracy is not a big concern. So, the artists simplify measurements using their own body parts and some known estimations, as narrated by Hudson, and shown in Figure 1a:

Hudson: Para fazer um metro, é só esticar o braço, entendeu? Sabia que teu isso aqui do braço [antebraço] é do tamanho do seu pé? Teu braço aberto é o teu tamanho. E teu pescoço é a tua cintura.  
*To measure one meter, all you must do is stretch out your arm, okay? Did you know that your forearm is the same length as your foot? Your extended arms or wingspan is the same as your height. And the circumference of your neck is the same as your waist.*

In turn, the activity of modelling and cutting the fabric to make the costumes (Figure 1b) requires performing arithmetic calculations to know how many folds will be needed in the material. In this process, school mathematics concepts are used, such as addition and multiplication operations. Moreover, geometric thinking is essential to optimize the available fabric, as artist Sandra describes:

Sandra: [É um processo demorado] por causa dos cálculos. Tem que calcular quantas peças vai dar, qual a melhor forma de aproveitamento do pano, se o pano que a gente tem é suficiente. Por exemplo, agora eu ia fazer 5 M e 5 XG. Só que se eu coloco o molde aqui, ele vai me sobrar esse tanto aqui. Então tenho que pensar o que é mais conveniente pra escola.  
*[It is a lengthy process] because of the calculations. We must calculate how many costume pieces there will be, what is the best use of the fabric, as well as whether there will be enough. For example, now I'm making 5 medium-size pieces and 5 extra-large pieces. But if I put the pattern here, I'll have this much left over. So, I must think about what is most convenient for the samba school.*



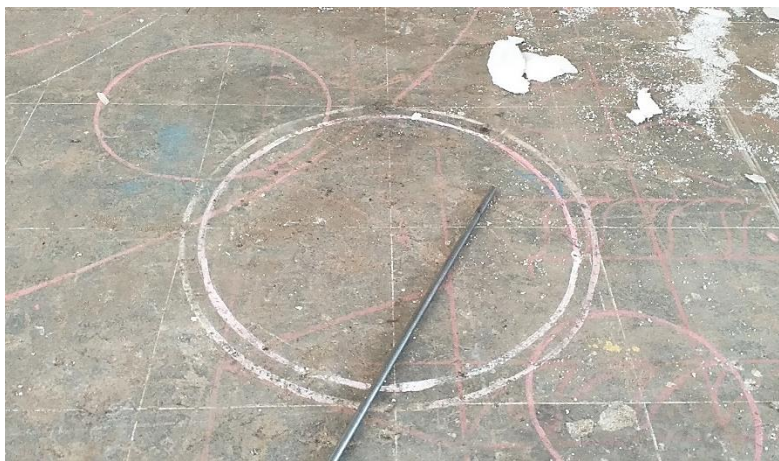
Figure 1a: Hudson estimates one meter of fabric



Figure 1b: Sandra marks patterns on the fabric

These narratives and figures suggest an oral and embodied mathematics, as they articulate their mathematical thoughts while performing calculations aloud, moving around, and scribbling. A great deal of reports by Knijnik et al. (2019) show subjects from studies in ethnomathematics performing oral mathematical operations to solve everyday situations, marking this practice as a trait of the *tics* of *mathema* in different *ethnos*. While academic mathematics emphasizes writing and accuracy, their mathematics does not strive to be translated into the formalism of written algorithms. Nevertheless, it is effective for its specific purpose and is expressed through scribbles, spoken words, and thoughts.

When making floats, Mestre Louro draws a grid on the floor with chalk and then uses a scale ruler to convert the project measurements into real measurements. To draw curved pieces, as in Figure 2, he improvises a compass with chalk and thread. The team uses these marks as a model to forge the metal bars that will structure the floats.



**Figure 2: Grid and drawn curved piece**

When we asked Louro how he knew the size of the metal bar to forge a circle, he replied:

Mestre Louro: É fácil. É só multiplicar esse pedaço aqui [diâmetro] por 314, é sempre por 314.  
*It's easy. All you must do is multiply that part [referring to the diameter] by 314, it's always by 314.*

In this way, Louro calculates the circumference by multiplying the diameter of a circle by the number  $\pi$  ( $\pi \approx 3.14$ ). To do so, he performs a conversion of units of measurement that simplifies the operation, so that it is not necessary to multiply the diameter by a decimal number (3.14) but by an integer (314). Skills for converting units of measurement are used intuitively but not thoughtlessly, as the artists know the orders of magnitude of the pieces they create due to years of experience.

Our findings indicate that mathematical concepts and operations are present in various samba school activities. These practices involve geometrical and proportional reasoning, measurement, estimation, and calculation, among other cognitive processes. Furthermore, the artists create sewing, drawing, forging, manufacturing, and resource optimization techniques. The practices carried out by these artists can be understood from the concept of technocracy (D'Ambrosio, 2005), which is the ability to use and combine material instruments, including the body, evaluating possibilities and limitations for different needs and situations. Therefore, techniques (*tics*) are created and shared to learn how to deal (*mathema*) with their specific social and work demands (*ethno*) effectively.

## Cross considerations

The associations' mathematical practices came mainly from curiosity, observation, imitation, and repetition. Thus, their pedagogy is based on several processes in which subjects educate themselves on collective citizenship (Freire et al., 1997), in their relationship with each other and with the (samba) world – inspired by Freire's approach to popular education (Freire, 2021).

Recognizing that there is no universal mathematics – defined solely by white, masculine, urban, and Western criteria – but rather that mathematics takes on context-specific forms, we were able to learn from the samba schools ways of knowing and doing mathematics that are practiced by people whose right to be recognized as knowledge producers is often denied. In this context, we reflect on Santos's (2007) discussion on abyssal thinking and its radical line, which is an invisible line sustaining all the distinctions between valid and non-valid knowledge, between popular education and university, and even between valid and non-valid lives:

Modern Western thinking is an abyssal thinking. It consists of a system of visible and invisible distinctions, the invisible ones being the foundation of the visible ones. The invisible distinctions are established through radical lines that divide social reality into two realms, the realm of 'this side of the line' and the realm of 'the other side of the line'. The division is such that 'the other side of the line' vanishes as reality becomes nonexistent, and is indeed produced as nonexistent. Nonexistent means not existing in any relevant or comprehensible way of being. (2007, 45)

To gain a deeper understanding of this concept, we created an image (Figure 3), crossing it with a quote from Father Vilson Groh, a religious and community leader who lives in the Monte Serrat community. Father Groh's life and activism were celebrated in the "Embaixada Copa Lord" carnival parade in 2019, which claimed for social justice.

Father Groh: São duas cidades – a linha divisória é a Mauro Ramos. O lado do Morro é invisível.  
***There appears to be two cities in one – the dividing line is Mauro Ramos Avenue.  
Our community's side is invisible.***

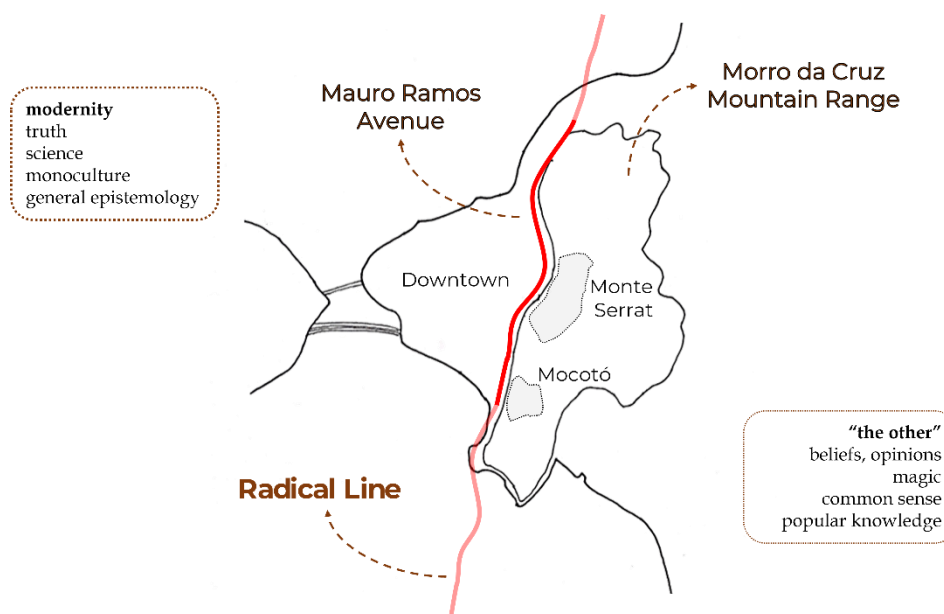


Figure 3: Scheme of abyssal thinking, translated from (Fernandes, 2020)

Due to its political dimension, the Ethnomathematics Program is particularly concerned with cultural contexts that have historically suffered attempts at subordination and invisibility. In fact, the ways of knowing and doing mathematics in samba schools are often overlooked and undervalued, which reflects a broader issue of abyssal thinking and the invisibility of certain communities. Interestingly, the concept of invisibility emerged at the beginning of our fieldwork when a participant asserted that conducting research in a samba school would be impossible because, in his view, mathematics did not exist in that context. In a similar vein, Freire et al. (1997, p. 8) made the claim that “when we referred to mathematics, we were referring to something suited for gods or for geniuses”.

This highlights how mathematics is often seen as something disconnected from real life, particularly for those in communities or favelas, as it is viewed as something reserved, throughout these radical lines, for white people in urban centres. This raises the question, as Freire et al. (1997, p. 8) did: “As a consequence, how many critical intelligences, how much curiosity, how many enquirers, how many capacities that were abstract in order to become concrete, have we lost?”.

Crossing to the end of fieldwork and this paper, we have an account by Dana, who said in our interview after the parade:

Dana: E nós dentro do barracão a gente usa isso [matemática] sempre. Sempre, sempre, sempre. Porque tem que tá pensando ‘será que a quantidade que tem vai dar?’, tem que tá medindo, somando, multiplicando a quantidade que vem de paetê no rolo pra quantidade de fantasia que tem pra ser decorada. [...] A gente não se dá conta diariamente, mas eu acho que é um dos caminhos que a gente mais usa pra que a coisa toda dê certo [...] Então dessa forma hoje eu percebo que a tua vinda pra escola também foi extremamente importante, Jéssica, porque a gente começou a perceber o quão fundamental é essa matéria dentro do nosso trabalho.  
***We use math all the time at the carnival workstation. We use it always, always, always. Because we must think ‘is the material enough?’. We have to measure, add, and multiply the amount of spangles we have on a roll by the number of costumes that need to be decorated. [...] We may not realize it on a daily basis, but I think it's one of the main tools we use to ensure everything runs smoothly [...] Today I realize that your presence at the samba school was so important, Jessica, because we began to realize how fundamental this topic is to our work.***

It is not surprising to us, however, that samba schools are spaces for the development of techniques and technologies, including mathematical ones, that enable the creation of the most diverse carnival artifacts. Moreover, we have observed that the artists use their bodies, tools, and techniques to solve problems, such as measuring and cutting fabrics, drawing and constructing shapes, and optimizing resources, reflecting a unique way of knowing that is closely tied to their social and cultural context.

Overall, the study underscores the need for an educational approach that considers the contexts in which mathematical knowledge is practiced and learned. In this sense, we highlight the emergence of ethnomathematics as a research field and a political-pedagogical position, which strives for the recognition that every cultural group develops its own ways and styles of explaining, understanding, and coping with its environment as a result of its rationality (D’Ambrosio, 2006). By broadening the limits of Western mathematics, ethnomathematics provides a basis for building a theory of knowledge that is closely related to struggles for social justice through cognitive justice. In this regard, we support the potential of samba schools in teaching us how to recognize and respect diverse ways of living, understanding, and doing mathematics.

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