

**FROM ERASURE TO RECOGNITION: PRE-COLUMBIAN ETHNOMATHEMATICS AND ITS POTENTIALITIES FOR MATHEMATICS EDUCATION** <https://doi.org/10.63330/aurumpub.022-014>**Valéria Pissolato dos Santos<sup>1</sup>, Luiz Antonio dos Santos Magalhães<sup>2</sup>, Gisele de Oliveira Montanha Puruborá<sup>3</sup>, Bruna Monteiro Marinho<sup>4</sup> and Kesia Santana Machado de Sousa<sup>5</sup>****ABSTRACT**

The present chapter addresses Ethnomathematics as a field for valuing knowledge produced by non-Western civilizations, specifically focusing on the mathematical legacy of Pre-Columbian peoples. This is a qualitative and theoretical bibliographic research that revisits the historiography of mathematics to counter the Eurocentric narrative predominant in school curricula. The main objective of the study is to investigate the mathematical systems developed by the Maya, Aztec, and Inca peoples and discuss their pedagogical potential for a more inclusive and intercultural Mathematics Education. The methodology consisted of a literature review grounded in Ethnomathematics theorists, such as Ubiratan D'Ambrósio, and in historical and archaeological records on Mesoamerican and Andean science. The results demonstrate the high sophistication of these peoples: the Maya developed a positional vigesimal numeral system and the abstract concept of zero for astronomical purposes; the Aztecs used functional pictograms for tax accounting and urban planning; and the Incas created Quipus, a complex logical system of strings and knots for data recording and engineering. It is concluded that this knowledge transcends folklore and possesses scientific rigor, offering educators powerful tools to teach concepts of arithmetic, geometry, and information processing, in addition to promoting the recognition of cultural diversity and combating epistemicide in student education.

**Keywords:** Ethnomathematics; Pre-columbian; Mathematics Education; Interculturality.

---

<sup>1</sup> Master's Student in Mathematics Education – PPGEM  
Federal University of Rondônia – UNIR

E-mail: [pissolato.2011@gmail.com](mailto:pissolato.2011@gmail.com)

LATTES: <http://lattes.cnpq.br/6764232004626990>

<sup>2</sup> Master's Student in Mathematics Education – PPGEM  
Federal University of Rondônia – UNIR

E-mail: [luiz\\_nbo@hotmail.com](mailto:luiz_nbo@hotmail.com)

LATTES: <http://lattes.cnpq.br/6632498729251318>

<sup>3</sup> Master's Student in Geography Teaching – PROFGEO  
Federal Institute of Rondônia – IFRO

E-mail: [montanhagisele@gmail.com](mailto:montanhagisele@gmail.com)

LATTES: <http://lattes.cnpq.br/7705105695517301>

<sup>4</sup> Master's Student in Natural Sciences Teaching – PGECN  
Federal University of Rondônia – UNIR

E-mail: [brunnajipa@gmail.com](mailto:brunnajipa@gmail.com)

ORCID: <https://orcid.org/0009-0005-5618-0180>

<sup>5</sup> Master's Student in Mathematics Education – PPGEM  
Federal University of Rondônia – UNIR

E-mail: [kesiamachadosousa@gmail.com](mailto:kesiamachadosousa@gmail.com)

ORCID: <https://orcid.org/0000-0001-5134-4936>



## INTRODUCTION

Mathematics as taught in Brazilian schools still relies largely on a Eurocentric narrative that privileges the contributions of thinkers and traditions from the Old World, as if science were an exclusive creation of Europe. This hegemonic and universalist perspective tends to silence knowledge produced by other cultural matrices, marginalizing sophisticated mathematical practices of civilizations native to the Americas. Peoples such as the Maya, Inca, and Aztec developed, centuries before the arrival of colonizers, vigesimal numeral systems, highly precise astronomical calendars, and complex works of engineering and architecture. This knowledge was not isolated; it integrated technique, spirituality, agricultural needs, and social organization, revealing a unique and effective way of reading and interpreting the world.

Despite its undeniable historical and scientific relevance, such knowledge often remains invisible in school curricula or, when addressed, is reduced to folkloric curiosities devoid of mathematical rigor. The central problem guiding this study lies in the “historical erasure” and epistemological devaluation of Pre-Columbian mathematics in formal education. We ask: in what ways does the perpetuation of a monocultural curriculum limit students’ critical formation and prevent the recognition that mathematics is a diversified human construction? This silencing is not mere forgetfulness; it reflects a structure of power that validates only Western science as legitimate.

The investigation of this theme is justified by the urgent need to promote cognitive justice in the school environment. By neglecting the intellectual contributions of native peoples, the school weakens the bond of Latin American students with their own cultural roots and perpetuates the erroneous idea that their ancestors did not produce science. Reintegrating such knowledge is fundamental to combating epistemic racism and providing plural models of logical reasoning. Moreover, for the mathematics teacher, contact with non-decimal numeral systems and distinct recording logics (such as quipus) enriches the didactic repertoire and challenges students to think outside the “box” of the traditional Indo-Arabic system.

Theoretically, this work is grounded in the Ethnomathematics Program proposed by Ubiratan D’Ambrósio, which asserts that each culture develops its own “mathematics”—that is, its own techniques for explaining and dealing with reality—in response to its needs for survival and transcendence. It also dialogues with the concept of “coloniality of knowledge,” from sociologist Aníbal Quijano, which explains how the hierarchy of knowledge imposed by colonialism continues to operate in contemporary scientific validation. This theoretical basis allows us to understand that Pre-Columbian mathematics has the status of science and that its exclusion results from a coloniality that needs to be overcome through education.



In light of this scenario, this chapter has the general objective of investigating the fundamental characteristics of the mathematical systems of the Maya, Aztec, and Inca civilizations and discussing their pedagogical potentialities for current Mathematics Education. As specific objectives, we seek to: (a) describe the technical advances of these peoples, such as the Maya zero, Inca recording systems, and Aztec geometry; (b) review the relevant historical and ethnomathematical literature to understand the internal logic of these systems; and (c) present reflections on how these contents can be transposed to the classroom, promoting meaningful and intercultural learning.

To understand the depth of the knowledge that has been silenced and to substantiate the proposed pedagogical discussion, it is first necessary to undertake a historical and epistemological recovery. The following section is dedicated to the literature review on the mathematical production of the Maya, Aztec, and Inca civilizations, showing how these peoples developed complex and rational logical systems long before contact with European colonizers.

## **LITERATURE REVIEW: ETHNOMATHEMATICAL PRODUCTION OF PRE-COLUMBIAN CIVILIZATIONS**

The Maya, Aztec, and Inca civilizations developed mathematical systems deeply intertwined with their cosmologies, everyday practices, and forms of political, economic, and territorial organization. Far from being mere technical instruments, their mathematical knowledge was also a form of symbolic expression, social control, and mediation with the spiritual world. According to D'Ambrosio (2001, p. 33), creator of the term Ethnomathematics, there are “different ways of explaining, understanding, and dealing with quantitative, spatial, and logical realities practiced by different cultural groups throughout history.” For the author, such knowledge must be recognized as legitimate expressions of ethnomathematical knowledge.

These civilizations elaborated numeral systems, calendars, instruments of record-keeping, and sophisticated urban planning, revealing a mathematical rationality of their own—distinct from Western logic, yet equally complex and effective. Even so, Brazilian textbooks and school curricula continue to neglect these contributions, reinforcing a narrative that associates mathematical knowledge exclusively with the European tradition (Rosa & Orey, 2012, p. 35).

### **THE MAYA: ASTRONOMY, CALENDARS, AND THE CONCEPT OF ZERO**

The Maya stood out for the depth and sophistication of their astronomical and mathematical knowledge, developed in intimate relation with their cosmology and social organization. Maya mathematics was not merely a technical tool, but a symbolic and ritual expression of their way of life and worldview, revealing a proper logic of timekeeping, recording, and astronomical prediction. According to



D'Ambrósio (2005, p. 30), “every culture develops its own mathematics as a function of the needs of survival and coexistence,” and in this sense, Maya mathematical knowledge constitutes a legitimate cultural system shaped by the demands and beliefs of its people.

The Maya elaborated two principal calendars: the Tzolk'in, of 260 days, geared toward religious activities and sacred cycles, and the Haab', of 365 days, used for administrative and agricultural functions. The intersection of these two systems resulted in the so-called Calendar Round, a cycle of 52 solar years, which guided ritual, political, and productive life in Maya society. As Coe and Houston (2015, p. 47) highlight, this mastery of astronomical cycles allowed the Maya to predict eclipses and align their social events with celestial movements, revealing a cyclical conception of time that was profoundly sacred.

In the numerical domain, the Maya employed a vigesimal system (base 20), formed by three essential symbols: the dot (value 1), the bar (value 5), and the shell (representing zero). This system allowed for the composition of integers through positional notation, increasing in vertical columns from bottom to top, in a model of notable abstraction and functionality. As Gendrop (1987, p. 30) states: “[...] the dot for the unit, the bar for five, plus a sign in the form of an elongated shell equivalent to ‘zero’, or rather, signifying absence of value. These signs lent themselves easily to composing integers, capable of surpassing the thousands.”

This use of zero as a mathematical symbol—one of the earliest records of this concept in the ancient world—demonstrates the advanced level of abstraction attained by the Maya. Restall (2003, p. 52) notes that it was “one of the most advanced numeral systems of antiquity, with the Maya being pioneers in the use of zero as a mathematical concept.” This achievement precedes by centuries the use of zero in European and Indian mathematics, contradicting the Eurocentric narrative that mathematics developed exclusively in the West.

Beyond counting, Maya numbers also had ritual and cosmological functions: each number was associated with deities and spiritual forces, and its use in the calendars indicated auspicious or unfavorable days for certain actions, such as planting, marriages, and wars (Santos et al., 2023, p. 4). Thus, mathematics was interwoven with spirituality and everyday life, constituting a form of mediation among the human, natural, and divine worlds.

This knowledge, however, remains historically marginalized in school curricula and textbooks. Rosa and Orey (2012, p. 35) denounce the persistence of a monocultural logic in Brazilian Mathematics Education that privileges exclusively knowledge originating in the European tradition. The invisibilization of Maya mathematics, in both its technical and symbolic dimensions, is a clear example of what Quijano (2005) calls the “coloniality of knowledge,” that is, the systematic erasure of non-Western epistemologies resulting from a hierarchy imposed by colonialism.

---

### **Education and Knowledge: Past, Present and Future**

Reintegrating these contributions into mathematics teaching is, therefore, an act of epistemic and pedagogical justice. Valuing diverse mathematical knowledge allows us to “expand students’ cognitive and cultural repertoire, promoting the recognition and appreciation of different ways of thinking and organizing the world” (Rosa & Orey, 2015, p. 220).

## THE AZTECS: URBANISM, TAXATION, AND PICTOGRAMS

Influenced by Mesoamerican cultural traditions, the Aztecs developed a numeral system based on base twenty, structured differently from the Maya, with greater emphasis on the use of pictograms. These symbols were recorded in codices—illustrated manuscripts on amate paper—and functioned as true visual systems of quantification and administration, employed in records of tributes, agricultural mapping, census organization, and urban planning of the empire (Baquedano, 1998, pp. 89–90).

Aztec numbers were represented by stylized everyday objects: dots for units, flags for multiplications by 20, feathers for hundreds, and bags for thousands. This numerical iconography, recorded in codices, facilitated the empire’s fiscal and administrative control (Baquedano, 1998; Coe & Houston, 2015). As we can see in the following figure:

Figure 1: Aztec Numeral System



Source: Mateprehispánicas (2020).

The figure illustrates the symbols used by the Aztecs in their vigesimal system: the dot for the unit, the flag for the value 20, the feather for 400, and the bag for 8,000. This model of representation was based on elements of daily life and was widely understood by the population, especially in administrative and fiscal records.

Such a system shows that the Aztecs did not conceive mathematics solely as abstraction but as a functional and culturally situated instrument, applied to taxation, urban planning, and social organization. The use of pictograms reinforces the visual and symbolic dimension of counting, revealing a rationality of its own, distinct from the Western tradition.



## THE INCAS: THE QUIPU AND ANDEAN ENGINEERING

The Incas, one of the most sophisticated civilizations of Pre-Columbian America, developed social, political, and territorial organization articulated with mathematical knowledge. Settled in the Andes, they mastered techniques of counting, geometry, astronomy, and engineering with a precision that still impresses specialists.

Among their innovations, the quipu stands out—a system of colored strings with knots, used as an instrument of record-keeping, calculation, and memory. According to Urton (2003, p. 45), the quipu was not merely a rudimentary abacus but a “structured mathematical language” that expressed quantities, categories, and logical relations through variations in color, thickness, length, and position of the knots.

This structure was based on decimal and positional principles, demonstrating a binary logic that allowed for storing complex data related to administration of the empire, such as agricultural production, census, and tributes (Urton, 2003, p. 57; Favre, 2004, p. 68). Favre (2004, p. 68) explains that “each small cord corresponded to objects of the same nature, while the knots expressed their numerical value,” revealing a proper mathematical rationality which, although distinct from European algebra, was equally advanced, articulating language, accounting, and worldview.

Beyond abstract mathematics, their architectural works, such as Machu Picchu, Sacsayhuamán, and Cusco, demonstrate techniques of fitting stones without mortar, resisting earthquakes for centuries. These constructions incorporated principles of symmetry, geometry, and astronomical alignments, reflecting a deep relationship between technique and spirituality (Coe & Houston, 2015, p. 112; Favre, 2004, p. 72; Vilca, 2022, p. 10).

The Inca lunar calendar, divided into 12 months, guided agricultural activities, rituals, and time management, showing a view of time as cycles connected to nature, celestial bodies, and spirituality (Favre, 2004, p. 69). Despite such sophistication, Inca mathematical knowledge remains marginalized in school curricula due to the coloniality of knowledge, which hierarchizes knowledge and delegitimizes non-Western epistemologies, relegating them to folklore or historical curiosity (Castro-Gómez, 2005, p. 76).

Ethnomathematics, proposed by D’Ambrósio (2005), emerges as a fundamental field for valuing these traditions, promoting a more democratic, plural, and anti-racist school that recognizes the mathematical knowledge of native peoples (Rosa & Orey, 2012, p. 215). Thus, the Incas—with their quipus, monumental cities, and lunar calendar—lived mathematics as a way of inhabiting the world with meaning, beauty, and precision.

Their vestiges, myths, and memories continue to cry out for recognition. The images that follow illustrate how different mathematical rationalities manifest in cultural practices, strengthening the view of Ethnomathematics as a pedagogical field committed to cognitive justice and epistemic plurality.

### **Education and Knowledge: Past, Present and Future**



The image presented below aims to illustrate how different mathematical rationalities materialize in specific cultural practices. Such visual representations contribute to strengthening the argument of Ethnomathematics as a theoretical and pedagogical field committed to cognitive justice and recognition of epistemic plurality.

Figure 2: Example of an Andean Quipu (record-keeping system using strings and knots)



Source: Brainly (2025)

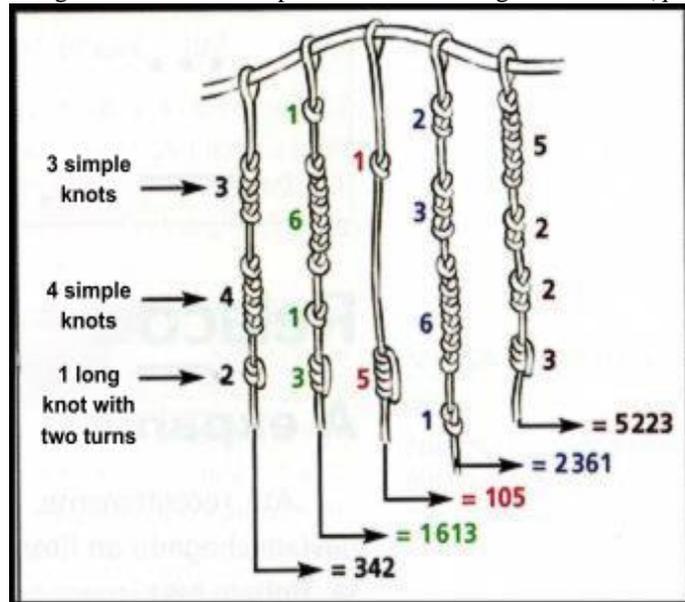
The quipu consisted of a cord measuring a few centimeters more than one meter in length. From this cord hung various small cords with knots, twists, and varied colors. Each small cord thus singularized corresponded to objects of the same nature, while the knots it contained expressed the numerical value of these objects (Favre, 2004, p. 68).

Figure 2 illustrates a didactic example of how different combinations of knots on strings can represent numerical values, evidencing the mathematical logic present in traditional systems such as Andean quipus. This type of representation directly confronts the idea that Mathematics is exclusively symbolic and algebraic, by demonstrating that there are numerical rationalities constructed in specific cultural contexts and based on their own recording technologies.

The presence of elements such as repetition of simple knots, double knots, and long knots, organized according to positions and sequences, reveals a structured logical system that operates outside the Western written matrix, yet still fulfills functions of counting, organization, and memory. This visual resource reinforces the argument of Ethnomathematics by defending the legitimacy of multiple forms of mathematical knowledge and the need to recognize these practices in school curricula.



Figure 3: Numerical representation on strings with knots (quipus)



Source: Mundo Incas 2016)

Figure 3 presents an authentic quipu, an artifact used by Andean peoples as a system of record-keeping and communication. The richness of colors, thicknesses, and knot patterns not only evidences the complexity of the system but also demonstrates its sophistication as a form of data encoding. Unlike alphabetic writing, the quipu operated based on a three-dimensional, tactile and visual language, capable of recording economic, demographic, tax, and possibly narrative information.

The analysis of this object, in the context of Ethnomathematics, expands understanding of the epistemological diversity that underpins mathematical knowledge. At the same time, it points to curricular epistemicide that occurs when these systems are ignored or erased from the history of Mathematics taught in schools. Incorporating the study of quipus into the school curriculum not only enriches students' mathematical repertoire but also values identities and cultures systematically marginalized.

## INVISIBILIZATION OF MATHEMATICAL KNOWLEDGE IN SCHOOL EDUCATION

The mathematical knowledge of civilizations native to the Americas—such as the Maya, Aztec, and Inca—represents sophisticated knowledge that articulates cosmology, social organization, symbolic language, and logical rationality. However, this knowledge has historically been erased from school curricula and teaching materials in a process of epistemic silencing. The hegemony of the Greco-European tradition in Mathematics Education has imposed a monocultural, rationalist, and universalist conception of Mathematics that ignores diverse ways of thinking and calculating present in other cultures (D'Ambrósio, 2005, p. 30).

This erasure is not accidental but reflects a colonial logic of knowledge production and validation. Quijano (2005, p. 122) emphasizes that the “coloniality of knowledge” establishes a hierarchy among

### Education and Knowledge: Past, Present and Future



epistemologies, conferring validity only to those originating in the Western European axis. This hierarchy legitimizes the exclusion of mathematical knowledge from native peoples, relegating it to folklore or historical curiosity (Castro-Gómez, 2005, p. 76).

In practice, this invisibilization manifests itself in textbooks, which function as ideological instruments, mediating cultural and political conceptions and reproducing dominant worldviews. Capelato (2009, p. 118) states that school manuals “are part of the machinery for maintaining historical interpretations and projects of society.” Fonseca (2010, p. 57) reinforces that these materials omit or superficialize indigenous, African, and popular knowledge, forming a homogeneous and exclusionary narrative of Mathematics.

Studies indicate that when this knowledge appears in textbooks, it is generally presented superficially, as curiosities, without connection to the central contents of the discipline (Rosa & Orey, 2012; D’Ambrosio, 2005). D’Ambrosio’s (2005, p. 30) Ethnomathematics proposal seeks to break with this monocultural logic, asserting that every culture develops its own way of mathematizing reality in accordance with its historical and social needs. Recognizing mathematical plurality is a condition for a fairer, more democratic, and culturally situated education.

Rosa and Orey (2012, p. 213) reinforce that including traditional mathematical knowledge in the school curriculum strengthens cultural identities, values diversity, and promotes curricular justice. For them, the school should cease to be a space of exclusion and become an environment of recognition and dialogue among different epistemologies.

Thus, this research criticizes the invisibilization of non-Western mathematical knowledge—especially in textbooks adopted in Brazilian schools—and advocates its incorporation as part of the history of human knowledge. As Oliveira and Araújo (2023, p. 5) indicate, integrating the knowledge of native peoples into mathematics teaching is a way to combat epistemicide, recognize silenced subjects, and build a truly intercultural curriculum.

Given the sophistication of the mathematical systems presented and the finding of their historical erasure, it becomes fundamental to structure the investigative path that enabled the analysis of these data from an educational perspective. The following section describes the methodological procedures adopted in this research, detailing the steps for selecting the theoretical framework and the criteria used to identify, in these ancestral forms of knowledge, the pedagogical potentialities that will be discussed later.

## **METHODOLOGY**

This study is characterized as research with a qualitative approach, of the bibliographic and documentary type. The choice of this approach is justified by the nature of the object of study—the mathematical knowledge of civilizations that were extinguished or transformed by the colonial process—



which requires interpretive investigation of historical and archaeological sources, rather than manipulation of numerical variables. As Bogdan and Biklen (1994) point out, in qualitative research the central interest lies in understanding the meanings attributed by subjects to their actions and productions. In this sense, it is understood that “reality is socially constructed and that human experience is mediated by interpretation,” distancing this work from a purely descriptive character and situating it in an analytical and reflective perspective.

The methodological path was structured from a literature review along two complementary fronts. The first, historiographical in nature, sought to gather data on numeral systems, measurement practices, and astronomical records of the Maya, Aztec, and Inca peoples. To this end, reference works on the history of science and Mesoamerican and Andean archaeological studies were consulted. The second front, theoretical-pedagogical in nature, used the Ethnomathematics framework to analyze these data. We adopted as a premise D’Ambrosio’s definition (2005, p. 30), in which “every culture develops its own mathematics in function of the needs of survival and coexistence.” This theoretical lens was essential to remove the stigma of “primitive” frequently attributed to such knowledge, allowing it to be reclassified as sophisticated and legitimate intellectual processes.

Data collection and analysis followed a three-stage protocol: **(i)** Identification, in which excerpts explicitly describing mathematical practices (such as the Maya use of zero or the logic of knots in quipus) were selected; **(ii)** Contextualization, the stage in which such knowledge was reconnected to its original social functions (religious, administrative, or agricultural), avoiding anachronisms; and **(iii)** Pedagogical Transposition, the moment of reflection on how these contents can dialogue with the National Common Curricular Base (BNCC) and current teaching practice.

Interpretive analysis was guided by the search for “pedagogical potentialities,” that is, elements that could effectively contribute to mathematics teaching. Based on Rosa and Orey (2015, p. 220), the intention was to verify how this knowledge can “expand students’ cognitive and cultural repertoire, promoting the recognition and appreciation of different ways of thinking and organizing the world.” Therefore, the methodology employed here did not limit itself to compiling historical information but carried out an exercise in epistemological critique, confronting Eurocentric hegemony with the conceptual richness of Pre-Columbian ethnomathematics.

Finally, it is worth noting that the choice of sources prioritized authors who discuss the colonality of knowledge and the need to decolonize the curriculum, ensuring that the pedagogical discussion was aligned with contemporary demands for an anti-racist and plural education.

Having outlined the investigative path and theoretical lenses that support the research, it becomes necessary to translate these historical findings into concrete educational practices. The subsequent section is therefore devoted to presenting the pedagogical potentialities identified, demonstrating how

---

### **Education and Knowledge: Past, Present and Future**



Pre-Columbian Ethnomathematics can be didactically transposed to enrich the teaching of fundamental mathematical concepts and promote interculturality in the classroom.

## **RESULTS AND DISCUSSION: PEDAGOGICAL POTENTIALITIES**

The inclusion of Ethnomathematics in the school curriculum transcends a mere methodological or ideological choice; it is a normative and ethical directive supported by the National Common Curricular Base (Brazil, 2018). The Specific Competence in Mathematics states that the student must “*Recognize that Mathematics is a human science, the result of the needs and concerns of different cultures at different historical moments, and is a living science that contributes to solving scientific and technological problems and to underpin discoveries and constructions.*” This directive breaks with the traditional view of mathematics as a static, neutral, and exclusively European body of knowledge, opening space for the recognition of other rationalities.

Based on this legal premise and the literature review conducted, analysis of historical data revealed that Pre-Columbian mathematical systems offer rich epistemological models to operationalize this competence in the classroom. We observe that Maya, Aztec, and Inca mathematics was not limited to solving everyday survival problems but was structured as complex logical systems of abstraction, capable of modeling astronomical phenomena, managing large territories, and processing statistical data with rigor. Therefore, bringing this knowledge into the school environment does not mean simplifying teaching but rather complexifying it, offering students multiple pathways to access fundamental mathematical concepts.

Unlike a superficial multicultural approach where indigenous culture appears only as illustration or folklore on commemorative dates, the discussion proposed here advocates structural inclusion. This means using the logical structures of these civilizations—such as the positional vigesimal base of the Maya or the binarity of Inca quipus—to develop rigorous mathematical concepts in Arithmetic, Geometry, and Statistics. In doing so, the teacher not only teaches mathematics but also historicizes knowledge, demonstrating that different human groups, faced with similar problems, developed distinct and equally valid solutions.

In this context, the pedagogical potentialities identified in this research point to three principal directions: **a)** Cognitive, by challenging students to think in non-decimal bases and non-alphabetic recording logics; **b)** Historical, by restoring scientific authorship to native peoples of the Americas; and **c)** Social, by combating epistemic racism that hierarchizes knowledge. Below, we detail these potentialities through specific intervention proposals for each civilization studied, articulating them directly with the skills set forth in the BNCC.



Among the various possibilities for pedagogical intervention, Maya arithmetic stands out for its potential to provoke productive cognitive estrangement. By presenting a counting logic distinct from the Western one, this system paves the way for the first activity proposed in this study, aimed at deconstructing and reconstructing the concept of numerical base.

### THE MAYA VIGESIMAL SYSTEM: DECONSTRUCTING THE DECIMAL BASE

The Maya numeral system, positional and base 20, presents itself as a powerful cognitive tool for teaching Arithmetic. By confronting students with a grouping logic distinct from the decimal, the teacher provokes a healthy “cognitive conflict”: the student needs to understand the *concept* of base and not merely memorize rules.

Table 1 systematizes an intervention proposal focused on the construction of number, emphasizing the use of the body (fingers and toes) and the abstraction of zero.

Table 1 – Intervention Proposal: Maya Arithmetic

Curricular Element	Description of the Pedagogical Activity
Theme	Numeral System and Place Value (Base 20)
Skill (BNCC)	(EF06MA02) Recognize the decimal numeral system as the result of a historical process, comparing it with other numeral systems.
Resources	Beans (unit), popsicle sticks (value 5), and shells or bottle caps (zero).
Development	<ol style="list-style-type: none"> <li>1. <b>Contextualization:</b> Explain that the Maya counted using the 20 digits of the body.o.</li> <li>2. <b>Manipulation:</b> Challenge students to represent quantities (e.g., their own age) using Maya symbols, grouping by 5 and by 20.</li> <li>3. <b>Operation:</b> Perform simple sums by moving only the objects, without converting to Arabic numerals.</li> </ol>

Source: Prepared by the authors (2025).

Applying this activity allows discussion of the role of zero. In traditional school mathematics, zero is often taught merely as “empty.” In the Maya system, by using the shell to indicate that a place of value 20 or 400 was “complete,” students visualize zero as an operational placeholder. Moreover, the activity breaks automatism. To calculate in base 20, the student must activate multiplicative reasoning (each level above is worth 20 times more), which reinforces, by comparison, understanding of the decimal system itself (where each level is worth 10 times more).

If the Maya contribution enriches Arithmetic by challenging positional logic, the Aztec civilization offers equally valuable support for Geometry and Measurement. Shifting focus from numerical abstraction to spatial organization, the next subsection explores how the administrative needs of that empire spurred the development of measurement techniques that speak directly to school content on area calculation.



## AZTEC GEOMETRY AND MEASUREMENT: THE MATHEMATICS OF LAND

Aztec mathematics offers a practical context for teaching Geometry, specifically in calculating areas and perimeter. Historical records in the codices show that the Aztecs decomposed irregular plots into familiar shapes (triangles and rectangles) to calculate taxes, a practice that anticipates principles of area calculation by decomposition.

Table 2 presents how this age-old practice can be brought into the 7th and 8th grades, connecting abstract geometry with the social function of mathematics (taxation).

Table 2 – Intervention Proposal: Aztec Geometry and Algebra

Curricular Element	Description of the Pedagogical Activity
Theme	Area Calculation of Plane Figures and Introduction to Algebra.
Skill (BNCC)	(EF07MA31) Establish expressions for calculating the area of triangles and quadrilaterals; (EF08MA06) Solve problems involving area calculation.
Resources	Graph paper, fictitious maps of irregular plots, and a table of Aztec symbols.
Development	<ol style="list-style-type: none"> <li><b>Challenge:</b> The student assumes the role of an Aztec tax collector who must calculate the tax on an irregular plot (trapezoid or polygon).</li> <li><b>Resolution:</b> The student must decompose the figure into rectangles and triangles to calculate the total area.</li> <li><b>Recording:</b> The final value must be expressed using pictographic notation (e.g., flag = 20 units).</li> </ol>

Source: Prepared by the authors (2025).

This intervention enriches the geometry lesson by introducing the concept of mathematical modeling. Students perceive that the area formula ( $b \times h$ ) is not merely a school rule but a tool for solving real problems of territorial management. Moreover, the use of pictograms (where a “flag” substitutes for the number 20) functions as an intuitive introduction to Algebra and the concept of variable, in which a graphic symbol represents a fixed numerical value, facilitating the transition from arithmetic to algebraic language.

While Aztec mathematics provides visual tools for understanding space and measurement, the Inca civilization invites us to rethink the very nature of data recording. Moving away from two-dimensional graphic representation, the next subsection investigates a textile and three-dimensional technology that challenges the Western notion of writing, offering a unique material support for developing competencies in the Probability and Statistics strand.

## THE INCA QUIPU: BINARITY AND INFORMATION PROCESSING

Frequently, the history of mathematics focuses only on numeric writing. The Inca quipu, however, allows exploration of Probability and Statistics by showing that it is possible to store and process complex data through tactile and logical resources (strings and knots), without using ink and paper.

### Education and Knowledge: Past, Present and Future



Table 3 proposes the use of the Quipu to develop statistical literacy, challenging the view that technology is merely electronic.

Table 3 – Intervention Proposal: Statistics with Quipus

Curricular Element	Description of the Pedagogical Activity
Theme	Data collection, classification, and representation.
Skill (BNCC)	(EF05MA24) Interpret statistical data presented in texts, tables, and graphs and produce them.
Resources	Thick twine (main cord) and colored yarn.
Development	1. <b>Data Collection:</b> Conduct a class census (e.g., age, height, number of siblings).
Development	2. <b>Coding:</b> Define a “logical legend” (e.g., Blue strand = Boys, Red strand = Girls; Simple knot = 1, Long knot = 10).
Development	3. <b>Construction:</b> Students build the physical quipu with the collected data.
Development	4. <b>Reading:</b> Another group must “read” the quipu and translate the data back into a table.

Source: Prepared by the authors (2025).

Building the quipu in the classroom develops computational and algorithmic thinking. To create a quipu, students must categorize information, establish hierarchies (main cord vs. secondary), and create a binary reading code. The discussion should focus on how different civilizations created information technologies appropriate to their contexts. This combats the hierarchy of knowledge, showing that the absence of alphabetic writing among the Incas did not mean an absence of mathematical rigor or capacity for data management.

However, the impact of these pedagogical interventions is not limited to cognitive development or acquisition of technical skills. The presence of this knowledge in the classroom also carries a strong symbolic and political dimension. The last stage of this discussion therefore turns to the ethical implications of this work, analyzing how teaching Pre-Columbian mathematics contributes to building an anti-racist education and to complying with Brazilian educational legislation.

#### LAW 11,645/08 AS A POLITICAL-PEDAGOGICAL POTENTIALITY

When discussing the potentialities of Pre-Columbian Ethnomathematics, it is common to focus only on technical aspects (arithmetic and geometry). However, one of the greatest contributions of this knowledge to the school environment is its capacity to operationalize Law No. 11,645 of March 10, 2008. This legislation amended the National Education Guidelines and Bases (LDB – Law No. 9,394/96), making the study of “Afro-Brazilian and Indigenous History and Culture” mandatory across the official school curriculum, including Mathematics (Brazil, 2008).

Although legislation is often associated with History and Arts courses, its text is clear in determining that content must be taught across the entire school curriculum. In this context, Mathematics



plays a crucial role in combating what is called “epistemic racism.” By silencing the intellectual production of native peoples, traditional schooling perpetuates the myth of European cognitive superiority.

Frequently, mathematics teachers feel difficulty in complying with this law due to a lack of materials that are not merely illustrative. In this regard, the Maya, Aztec, and Inca systems emerge as a direct pedagogical potentiality because they offer rigorous mathematical content that places indigenous peoples as intellectual protagonists. Rather than approaching indigenous culture only from the perspective of folklore or art, working with Inca Engineering or Maya Astronomy combats what is called “epistemic racism”—the unfounded belief that the capacity for logical abstraction is exclusive to Euro-Western thought.

Bringing the sophistication of Inca engineering systems or the complexity of Maya astronomy into the classroom is a way to operationalize the law, demonstrating to students that mathematical rationality is an inherent characteristic of the human condition, not a privilege of a single ethnic group. This approach strengthens students’ identities, promotes respect for diversity, and deconstructs stereotypes that associate indigenous peoples with technological backwardness, repositioning them as producers of high-precision science.

Therefore, applying this content in the classroom is not a deviation from the mathematics curriculum but a didactic strategy for Anti-Racist Education. It allows the indigenous student to see themselves in the science they study and the non-indigenous student to respect ancestral knowledge, fulfilling the law’s objective of forming citizens aware of Brazil’s and Latin America’s cultural plurality.

Beyond complying with legislation and ethical commitment, it is imperative to highlight that this proposal is pedagogically effective. The articulation between culture and cognition is not an isolated invention but a vast field of study. The final stage of this discussion brings to light what scholars of Mathematics Education say about the validity and richness of teaching through the perspective of Ethnomathematics.

## POTENTIALITIES: DIALOGUES WITH MATHEMATICS EDUCATION

The pedagogical validity of using Pre-Columbian Ethnomathematics is widely corroborated by scholars in Mathematics Education. The main potentiality identified lies in the capacity to humanize the discipline. As Ubiratan D’Ambrósio (2005) argues, Ethnomathematics is not merely the study of “different mathematics,” but the analysis of how distinct cultural groups generate, organize, and disseminate knowledge to explain and deal with their reality. Applying this view shifts teaching from mere transmission of absolute truths to investigation of logical processes.



Complementing this view, Rosa and Orey (2012) highlight that the ethnomathematical approach strengthens students' cultural self-esteem. For these authors, when school mathematics dialogues with local or ancestral knowledge, a “translation” occurs that facilitates understanding of abstract concepts. By studying the Aztecs or Incas, students perceive that mathematics is a dynamic, living practice present in all civilizations, which combats mathematical anxiety and promotes a more inclusive and democratic learning environment.

In the same direction, Alan Bishop (1991) identifies six universal activities that give rise to mathematical knowledge: counting, locating, measuring, designing, playing, and explaining. The results of this research show that Pre-Columbian civilizations developed these activities with excellence—the Maya in “counting” (arithmetic), the Aztecs in “measuring” and “designing” (geometry), and the Incas in “locating” and “explaining” (data systems). Using these historical examples materializes Bishop's theory, proving to students that mathematics is a universal response to common human problems.

Furthermore, scholars such as Iran Abreu Mendes (2009) argue that the History of Mathematics should be used as a pedagogical resource for concept construction. Investigating how the Maya solved the problem of writing large numbers (creating zero and place value), the contemporary student retraces the cognitive path of discovery. This enhances learning, because the concept ceases to be an imposed rule (like “carry one” or “base 10”) and becomes understood as a historically constructed logical solution.

Finally, it is essential to bring in Leite's (2014) perspective, which emphasizes the need for a mathematics curriculum that dialogues with local and historical realities. For the author, valuing the mathematical knowledge of native peoples is not merely a historical recovery but a political and pedagogical act aimed at decolonizing thought and forming teachers and students conscious of their Latin American identity. In this view, Ethnomathematics becomes a tool for empowerment and critical reading of the world.

Therefore, the potentialities for Mathematics Education go beyond content: they reside in developing critical thinking, understanding the nature of science, and forming subjects capable of dialoguing with different rationalities—skills essential for the twenty-first century.

## **CONCLUSION**

This study undertook an investigative path, starting from the problem of historical erasure of Pre-Columbian knowledge and arriving at the proposition of its pedagogical potentialities. The literature review confirmed that the Maya, Aztec, and Inca civilizations developed highly complex mathematical systems that transcend a utilitarian vision of survival and reach sophisticated levels of abstraction and generalization.



Revisiting the proposed objectives, the research demonstrated that it is possible to identify rigorous mathematical logics in these cultures: the Maya vigesimal system and zero challenge understanding of positional arithmetic; Aztec land surveying offers alternative and effective methods for teaching geometry and areas; and Inca quipus prove to be a pioneering technology in information processing and data logic. It was thus confirmed that this knowledge has didactic potential to teach content set forth in the BNCC—such as numbers, quantities, and statistics—with the same rigor attributed to Western mathematics.

However, we conclude that the main contribution of this work does not reside solely in technique but in the ethical dimension of Mathematics Education. In answering the question about pedagogical potentialities, we identified that introducing this knowledge is an effective strategy for Anti-Racist Education. Although the term was not the initial focus of the historical review, analysis showed that teaching the science of native peoples is the most concrete way to combat “epistemic racism”—the idea that logical intelligence is the exclusive domain of Europeans.

In this sense, compliance with Law No. 11,645/08 ceases to be a bureaucratic imposition and comes to be understood as a pedagogical opportunity. Pre-Columbian mathematics provides teachers the tools necessary to operationalize this law—not through empty discourse but through practical demonstration of indigenous intellectual capacity.

As suggestions for future research, we recommend practical application of the pedagogical interventions outlined in this article in Basic Education classes. Field studies that analyze students’ reception and the impact of these activities on learning mathematical concepts would be fundamental to empirically validate the potentialities discussed here theoretically.

In sum, this chapter argues that recognizing Pre-Columbian Ethnomathematics in the school curriculum is urgent and necessary. Overcoming the historical erasure of these peoples is not only an act of memorial justice but also a path to forming students with an expanded cognitive repertoire and a more plural worldview, in which mathematics is understood as a universal, diverse, and human heritage.



## REFERENCES

1. Baquedano, Elizabeth. Os astecas [The Aztecs]. Tradução de Maria Georgina Segurado. São Paulo: Melhoramentos, 1998.
2. Bishop, Alan J. Enculturação matemática: uma perspectiva cultural sobre o ensino de matemática [Mathematical enculturation: a cultural perspective on the teaching of mathematics]. Tradução de Áurea Domene. Campinas: Papyrus, 1991.
3. Bogdan, Robert C.; Biklen, Sari Knopp. Investigação qualitativa em educação: uma introdução à teoria e aos métodos [Qualitative research in education: an introduction to theory and methods]. Tradução de Maria João Alvarez, Sara Bahia e Telmo Mourinho Baptista. Porto: Porto Editora, 1994.
4. Brainly. Exemplo de quipu andino [Example of Andean quipu]. 2025. Available at: <https://brainly.com.br>. Accessed on: 10 Dec. 2025.
5. Brasil. Lei nº 11.645, de 10 de março de 2008 [Law No. 11,645, of March 10, 2008]. Altera a Lei nº 9.394, de 20 de dezembro de 1996, modificada pela Lei nº 10.639, de 9 de janeiro de 2003, para incluir no currículo oficial da rede de ensino a obrigatoriedade da temática “História e Cultura Afro-Brasileira e Indígena”. Brasília, DF: Presidência da República, 2008.
6. Brasil. Ministério da Educação. Base Nacional Comum Curricular [National Common Curricular Base]. Brasília: MEC/SEB, 2018.
7. Capelato, Maria Helena Rolim. Ensino primário franquista: os livros escolares como instrumento de doutrinação infantil [Francoist primary education: school books as instruments of child indoctrination]. *Revista Brasileira de História*, São Paulo, v. 29, n. 58, p. 115–136, 2009.
8. Castro-Gómez, Santiago. *La hybris del punto cero: ciencia, raza e ilustración en la Nueva Granada (1750–1816)*. Bogotá: Pontificia Universidad Javeriana, 2005.
9. Coe, Michael D.; Houston, Stephen. *The Maya*. 9. ed. New York: Thames & Hudson, 2015.
10. D’Ambrosio, Ubiratan. *Etnomatemática: elo entre as tradições e a modernidade [Ethnomathematics: link between traditions and modernity]*. 2. ed. Belo Horizonte: Autêntica, 2001.
11. D’Ambrosio, Ubiratan. *Sociedade, cultura, matemática e seu ensino [Society, culture, mathematics and its teaching]*. *Educação e Pesquisa*, São Paulo, v. 31, n. 1, p. 99–120, 2005.
12. Favre, Henri. *A civilização inca [The Inca civilization]*. Tradução de Maria Julia Goldwasser. Rio de Janeiro: Jorge Zahar, 2004.
13. Fonseca, Maria da Conceição F. R. *Educação matemática de jovens e adultos: especificidades, desafios e contribuições [Mathematics education for youth and adults: specificities, challenges and contributions]*. 2. ed. Belo Horizonte: Autêntica, 2010.
14. Gendrop, Paul. *A civilização maia [The Maya civilization]*. Tradução de Maria Julia Goldwasser. Rio de Janeiro: Jorge Zahar, 1987.



15. Leite, Kécio Gonçalves. Nós mesmos e os outros: etnomatemática e interculturalidade na escola indígena Paiter [Ourselves and the others: ethnomathematics and interculturality in the Paiter Indigenous school]. 238 f. Tese (Doutorado em Educação em Ciências e Matemática) – Universidade Federal de Mato Grosso (UFMT), Rede Amazônica de Educação em Ciências e Matemática (REAMEC), Cuiabá, 2014.
16. Mateprehispánicas. Sistema de numeração asteca [Aztec numbering system]. 2020. Available at: <https://mateprehispanicas.blogspot.com>. Accessed on: 15 Nov. 2024.
17. Mendes, Iran Abreu. Matemática e investigação em sala de aula: tecendo redes cognitivas na aprendizagem [Mathematics and classroom investigation: weaving cognitive networks in learning]. 2. ed. São Paulo: Livraria da Física, 2009.
18. Mundo Incas. Quipus: o sistema de contabilidade inca [Quipus: the Inca accounting system]. 2016. Available at: <https://mundoincas.com>. Accessed on: 20 Nov. 2024.
19. Oliveira, Marcio; Araújo, Janny. Decolonialidade e Educação Matemática: caminhos para um currículo antirracista [Decoloniality and mathematics education: paths to an antiracist curriculum]. Revista Latinoamericana de Etnomatemática, v. 16, n. 1, p. 5–22, 2023.
20. Quijano, Aníbal. Colonialidade do poder, eurocentrismo e América Latina [Coloniality of power, Eurocentrism and Latin America]. In: Lander, Edgardo (org.). A colonialidade do saber: eurocentrismo e ciências sociais [The coloniality of knowledge: Eurocentrism and social sciences]. Buenos Aires: CLACSO, 2005. p. 117–142.
21. Restall, Matthew. Seven Myths of the Spanish Conquest. Oxford: Oxford University Press, 2003.
22. Rosa, Milton; Orey, Daniel Clark. O campo de pesquisa em etnomodelagem: as abordagensêmica, ética e dialética [The research field in ethnomodeling: emic, etic and dialectic approaches]. Educação e Pesquisa, São Paulo, v. 38, n. 4, p. 165–279, 2012.
23. Rosa, Milton; Orey, Daniel Clark. Polissemia na Educação Matemática: a etnomatemática como um programa de pesquisa [Polysemy in mathematics education: ethnomathematics as a research program]. Revista de Educação Matemática, São Paulo, v. 12, n. 15, p. 210–225, 2015.
24. Santos, Carlos A. et al. A matemática maia e suas implicações no ensino fundamental [Mayan mathematics and its implications in elementary education]. Revista Brasileira de Educação em Ciências e Educação Matemática, v. 7, n. 2, p. 1–15, 2023.
25. Urton, Gary. Signs of the Inka Khipu: Binary Coding in the Andean Knotted-String Records. Austin: University of Texas Press, 2003.
26. Vilca, Milton. Etnomatemática nos Andes: saberes e práticas [Ethnomathematics in the Andes: knowledge and practices]. Lima: Editorial Universitaria, 2022.