

Mathematical Education, Curriculum (In)Justice, and the (un)told History of Mathematics

Abstract: The overall objective of this paper is to express the reflections made during the opening panel of the *VI National Forum on Mathematics Curriculum*, held between October 9 and 11, 2024, in the city of Montes Claros. In terms of structure, the paper begins with the considerations of Zaqueu Vieira Oliveira, who discusses how the history of Mathematics can act as an ally of Mathematics education in promoting social justice. Next, Maria do Carmo de Sousa, based on a concept of curriculum justice, analyzes the Mathematics curriculum, defending anti-racist Mathematics Education. Finally, Flavio Augusto Leite Taveira articulates the discussions held with the curriculum debate in the field of Mathematics Education.

Keywords: History of Mathematics. Curriculum Justice. Anti-Racist Mathematics Education.

Educación Matemática, (In)Justicia Curriculum y la Historia (no contada) de las Matemáticas

Resumen: El objetivo general de este artículo es expresar las reflexiones realizadas durante el panel de apertura del *VI Foro Nacional de Currículo de Matemáticas*, realizado entre los días 9 y 11 de octubre de 2024 en la ciudad de Montes Claros. En términos de estructura, el artículo presenta inicialmente las consideraciones de Zaqueu Vieira Oliveira, quien discute cómo la Historia de las Matemáticas puede actuar como aliada de la Educación Matemática en la promoción de la justicia social. A continuación, Maria do Carmo de Sousa, a partir de un concepto de justicia curriculum, analiza el currículo de Matemáticas, defendiendo una Educación Matemática antirracista. Por último, Flavio Augusto Leite Taveira articula las discusiones mantenidas con el debate curriculum en el ámbito de la Educación Matemática.

Palabras clave: Historia de las Matemáticas. Justicia Curriculum. Educación Matemática Antirracista.

Educação Matemática, (In)Justiça Curricular e a História (não) contada da Matemática

Resumo: O objetivo geral deste artigo é expressar as reflexões realizadas durante o painel de abertura *VI Fórum Nacional sobre Currículo de Matemática*, realizado entre os dias 9 e 11 de outubro de 2024, na cidade de Montes Claros. Em termos de estrutura, o artigo apresenta inicialmente as considerações de Zaqueu Vieira Oliveira, que discute como a História da Matemática pode atuar como aliada da Educação Matemática na promoção da justiça social. Em seguida, Maria do Carmo de Sousa, fundamentada em um conceito de justiça curricular, analisa o currículo de Matemática, defendendo uma Educação Matemática antirracista. Por fim, Flavio Augusto Leite Taveira articula as discussões realizadas com o debate curricular no campo da Educação Matemática.

Palavras-chave: História da Matemática. Justiça Curricular. Educação Matemática Antirracista.

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ARTICLE

1 First words

This text expresses the reflections presented in the opening panel entitled “*National Reconstruction of Social Justice: the role of Mathematics Education*”, from the sixth edition of the *National Forum on Mathematics Curriculum*, held at the State University of Montes Claros, in the city of Montes Claros, Minas Gerais, Brazil, between October 9 and 11, 2024.

In it, Zaqueu Vieira Oliveira and Maria do Carmo de Sousa shared their thoughts on what they consider essential for Mathematics Education focused on social justice in the current context of Brazil, marked by a process of reconstruction. Flavio Augusto Leite Taveira, in turn, addressed the issues discussed from a curriculum perspective, with an emphasis on discussions about curriculum justice.

In terms of structure, the text begins with the considerations of Professor Zaqueu Vieira Oliveira, who discusses how the history of Mathematics can act as an ally of Mathematics Education in promoting social justice by valuing non-Eurocentric cultures, whose knowledge and practices were stolen and erased during the colonial process. Next, Professor Maria do Carmo de Sousa, based on a concept of curriculum justice, analyzes the Mathematics curriculum and its relationship with the logical-historical movement of mathematical concepts, defending anti-racist Mathematics Education. Finally, Flavio Augusto Leite Taveira seeks to articulate the previous discussions with the debate on Curriculum Justice in the field of Mathematics Education, emphasizing a close link with the History of Mathematics. Finally, final considerations are presented that highlight the contributions of Mathematics Education in the Brazilian scenario of social reconstruction focused on Social Justice.

2 What history of Mathematics is important for social justice?

When we talk to people in general, it is clear that they feel uncomfortable when we mention the word Mathematics. Various myths and misconceptions, usually negative, are associated with Mathematics (Oliveira, 2020; Sam and Ernest, 2000). In many cases, this is due to school experiences that involve formulas, algorithms, and a lack of clear and obvious meaning. But there is more to it than that. People do not understand the importance of mathematical thinking in dealing with everyday problems (Bianchini and Lima, 2023; Paulos, 1990). This same reaction occurs with people in the academic world, especially those who do not work in the exact sciences.

We cannot deny the importance of symbolism and algebra for the development of Mathematics. As João Pedro da Ponte, Neusa Branco, and Ana Matos (2009) state,

The truth is that we cannot minimize the importance of symbols. This importance is recognized, for example, by American mathematician Keith Devlin when he argues that “without algebraic symbols, much of Mathematics simply would not exist.” Algebraic language creates the possibility of distancing oneself from the semantic elements that symbols represent. In this way, algebraic symbols and their syntax take on a life of their own and become powerful tools for problem solving. (Ponte, Branco and Matos, 2009, p. 8).

In other words, it was the development of progressively more abstract concepts and language that enabled Mathematics to deal with increasingly complex problems.

However, this great potential of symbolism is also its great weakness. This life of its own tends to disconnect from its initial concrete references and runs the serious risk of becoming incomprehensible to the student. This is what happens when symbolism is used in an abstract way, without meaningful

references, turning Mathematics into a game of manipulation, guided by the repetitive practice of exercises involving algebraic expressions, or when only the properties of algebraic structures are highlighted in a wide variety of fields [...] (Ponte, Branco and Matos, 2009, p. 8).

This overvaluation of abstraction leads us to a reduced view of what Mathematics is — or what can be considered part of it. The Platonic conception of Mathematics tells us that, in an ideal world, there is a perfect, immutable, and eternal Mathematics. Silva (2007, p. 37) states that Platonic rationalism “attributes to human reason the power to penetrate the supersensible domains of Mathematics”, while transcendent ontological realism makes it possible to understand the “independent existence of mathematical entities in a realm outside this world”.

The immanent world is accessible to us through the senses, the transcendent only through reason or understanding. It is reflected in the former like clouds in the sky reflected in the waters of a lake, only imperfectly and approximately. In the empirical world, where we live with the objects that surround us, there are, for example, approximately circular figures and approximately good people, but only in the transcendent world of being, where Ideas and perfect essences dwell, are the very Idea of circularity, goodness without flaw, and perfect circles found. These are the models of the more or less circular figures and only roughly kind people of the sensible world. For Plato, knowing in the true sense consisted in ascending to the real world of being through the exclusive use of the faculties of intelligence: reason and understanding. It is said that an inscription on the portico of Plato's Academy warned those who did not know geometry not to enter, because he considered it not only an example of intellectual knowledge, but also a propaedeutic activity essential to philosophy itself. (Silva, 2007, p. 38-39).

It is this perception that emphasizes Mathematics as a divine activity, unique to a select group of brilliant individuals, and that places us, as human beings, on an eternal quest to discover and find a shadow, an imperfect image of this Mathematics.

This perception leads us to a widely held and accepted belief: that Mathematics is universal and unique, produced in a linear and neutral way.

Mathematics is an ancient science, practiced and accumulated since millennia before Christ uninterruptedly until today, and almost all peoples and civilizations have contributed to its development, first the Egyptians and Mesopotamian peoples of the most remote Antiquity, then the Greeks, Chinese, Indians, and Arabs, various European countries from the end of the Middle Ages, and finally the whole world. Even the Mayan civilization produced Mathematics, without any contact with the mathematical traditions of Europe, the Middle East, or Asia. It is difficult to find a nation today, however small or poor, where Mathematics is not practiced and created. Despite this diversity, there are not several Mathematics, but only one — even if there are national and even personal styles of Mathematics — with essentially the same language, the same concepts, and the same methods. The brotherhood of mathematicians covers the entire world. [...] (Silva, 2021, s. p.)

However, the history of Mathematics shows that the production of mathematical knowledge — much of which has generated concepts studied in basic education — is quite complex, closely related to everyday issues, and has been present in different cultures. The need

to count generated the concepts of numbers and the development of a series of numerical systems. The demands related to quantities and measurements led to the need to organize a system of measurements, which, due to a series of circumstances, was standardized. Issues related to location and movement, whether on land or at sea, led to a series of mathematical discoveries about the heavens and culminated in the production of a series of mathematical concepts, such as plane, spatial, and spherical geometry. In this sense, the concept of function developed in an attempt to understand a diversity of natural phenomena (Roque, 2012).

The history we are told does not show that various numbering systems were forgotten, mainly because some cultures did not have a writing system. Nor do we reflect on the impacts of standardizing measurement systems that disregard the various units of measurement used locally. The development of astronomy, physics, other areas of natural sciences, and Mathematics linked to them has disregarded all the ancestral knowledge about nature of a diversity of peoples.

In fact, the relationships between Mathematics and other areas of knowledge are very present throughout history, not only through examples, but in the very way scholars conceived of Mathematics. In fact, until the 17th century, Mathematics was considered a set of disciplines or sciences, Mathematics in the plural.

It is not just a question of plurality in the sense that each person understands an object differently, but rather in the sense that Mathematics could be conceived not as an object, a discipline, but as a set of related disciplines, Mathematics in the plural. (Gonçalves, 2012, p. 33).

This concept originated in the *quadrivium*, a set of four disciplines — Arithmetic, Geometry, Music, and Astronomy — that were part of the liberal arts. Several scholars added other disciplines to this group, broadening the scope of Mathematics. Luca Pacioli (1445-1517), John Dee (1527-1608), and Adriaan van Roomen (1561-1615) published works in which they presented a broad set of mathematical sciences or disciplines. For example, for these authors, Optics and Geography were considered parts of Mathematics (Bertato and D'Ottaviano, 2007; Oliveira, Silva e Godoy, 2021).

Figure 1 shows a diagram taken from van Roomen's work *Mathesis Polemica* (1605), in which mathematical disciplines are classified, including Geography and Optics as parts of Mathematics.

The conceptions of Mathematics in the 16th and 17th centuries included as mathematical knowledge those that had quantities as their object of study, a term that makes little sense in Mathematics today. However, for Pacioli, Dee, van Roomen, and many of their contemporaries, quantities were not just numbers and shapes, but encompassed everything that could be quantified, such as the movements of celestial bodies, the relationships between musical sounds, visual rays, and calculations of location on Earth (Oliveira, Silva and Godoy, 2021).

But throughout history, especially in recent centuries, Mathematics has gained a separate place from other fields. And while it has been able to develop so-called pure research in the school environment, it has had more and more space to emphasize its abstract aspects.

In addition, another extremely important aspect is that domination and conquests in colonial processes have had a profound impact on the way we conceive Mathematics. One of the strategies used by colonizers to dominate peoples and territories was to colonize knowledge and practices, saying and imposing that their knowledge was the only valid and possible one.

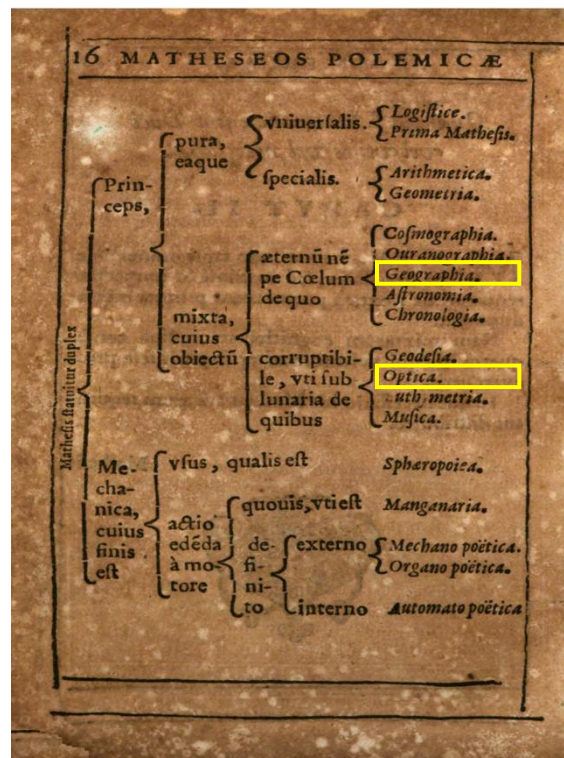


Figure 1: Diagram of Adriaan van Roomen's mathematical disciplines (1605). Two of these mathematical disciplines, Geography and Optics, are marked in yellow.

In this sense, some authors discuss the concept of coloniality of knowledge, that is, “the positioning of Eurocentrism as the exclusive order of reason, knowledge, and thought, which excludes and disqualifies the existence and viability of other epistemic rationalities and other forms of knowledge that are not those of white European or Europeanized men” (Walsh, 2012, p. 67). In this sense, it is understood that not only did the domination of territories occur, but also the domination of ways of thinking and producing knowledge.

“[...] the notion of coloniality of knowledge [...] refers to the effect of subalternization, folklorization, or invisibilization of a multiplicity of knowledge that does not respond to the modes of production of ‘Western knowledge’ associated with conventional science and expert discourse” (Restrepo; Rojas, 2010, p. 136).

This form of domination has become so ingrained in the social imagination that other forms of knowledge are not considered or even thought of as possible.

The coloniality of knowledge implies a kind of epistemic arrogance on the part of those who consider themselves modern and believe they possess the most appropriate (or even the only) means of accessing truth (whether theological or secular), and therefore assume that they can manipulate the natural or social world according to their own interests. Other forms of knowledge, generally associated with non-European populations, are dismissed as ignorance, belittled, inferiorized, or, on certain occasions, appropriated by the European theological, philosophical, and scientific apparatus of knowledge production. Hence the repressive character of the coloniality of knowledge in relation to other modes of knowledge production and other epistemic subjects (Restrepo and Rojas, 2010, p. 137, emphasis added).

In this way, Mathematics has earned and retained the nickname *a universal science*, operating in a way that disregards the knowledge and practices of different cultures as part of a broad process of production and practices that generate mathematical knowledge. According to Walsh (2012), the coloniality of knowledge

operates today in the discourse of many ‘progressive’ intellectuals who strive to discredit both the logic and rationality of knowledge that historically and still exist among many ancestral peoples and communities, as well as emerging attempts to construct and position ‘own thoughts’ of a decolonial nature, characterizing both as fundamentalist, essentialist, and racist fabrications (p. 67).

Thus, the authors urge us to think about how the history we are told was constructed and how, in this process, knowledge and practices were stolen and erased. We use these two terms — stolen and erased — to propose and emphasize two categories that exemplify and highlight the different ways of colonizing knowledge. There is knowledge and know-how from different peoples and cultures that has been stolen, plagiarized, and disseminated by Europeans as if it were their own. On the other hand, the delegitimization of the history and customs of different cultures has led to the complete erasure of a wealth of knowledge, much of which can never be recovered. By being discredited and erased from history, this process has made knowledge and practices non-existent (Oliveira, 2024).

We will now present an example of each of the categories proposed above. Have you ever heard of Pascal's triangle? It is an infinite arithmetic triangle formed by binomial numbers. To construct it, a number is chosen to be the generating element — usually the number 1 — but it can be any other number. The basic rule assumes that each element must be the sum of the two above it, and if there are no two previous elements, it must be equal to the generating element (Figure 2). In this triangle, it is possible to find various sequences, sums, combinations, and binomial coefficients.

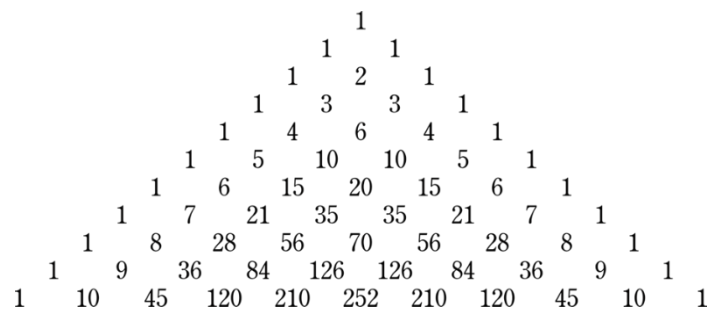


Figure 2: Arithmetic triangle constructed from the number 1 as the generating element (Wikimedia Commons)

The arithmetic triangle is commonly attributed to French mathematician Blaise Pascal (1623-1662), who published the work *Traité du triangle arithmétique* in 1665. In this text, Pascal presents the uses of the arithmetic triangle for working with numerical progressions and combinatorial analysis. However, what we do not usually read in history books is that studies on the arithmetic triangle were carried out by other mathematicians over time, among whom we will mention three.

The first example is that of the Chinese mathematician Jiǎ Xiàn, who lived in the 11th century. Among his works, he devoted himself to what we now call the binomial theorem in elementary algebra, presenting results for binomial coefficients in the form of an arithmetic triangle. His studies were later further developed by Yáng Huī and Zhū Shìjié, Chinese mathematicians of the 13th century (Edwards, 2019).

Al-Samaw' al ibn Yaḥyā al-Maghribī, who lived in the 12th century in Baghdad (now Iraq), is our second example. Al-Maghribī studied binomial coefficients and constructed an arithmetic triangle based on the studies of Abū Bakr Muḥammad ibn al Ḥasan al-Karajī, a Persian mathematician who also contributed to the development of ideas related to mathematical induction (Edwards, 2019).

We also mention Ibn Mun'im, an Andalusian mathematician who lived most of his life in Marrakesh (now Morocco), where he died in 1228. His work *Fiqh al Hijāb*, published between 1207 and 2012, was an important treatise on combinatorial analysis of that period, in which Mun'im devoted a section to the study of the arithmetic triangle (Figure 3). Mun'im's work presents combinatorial problems that seek to understand all the possibilities of words written in Arabic formed by a given number of letters (Djebbar, 1985).

أ. قوانين كلية

مسألة-(4) توطئة لها نحن بسبيله :

عشرة ألوان من الحرير ، أردنا أن نعمل منها شراريب ، بعضها من لون لون ، وبعضها من لونين لونين وبعضها من ثلاثة ألوان ثلاثة ألوان وكذلك إلى أن تكون آخر شرابية من عشرة ألوان ، وأردنا أن نعلم كم عدد كل نوع نوع على انفراد ه من أنواع الشراريب ، ألوان كل شرابية منها معلومة ، أو كم عدد جميع الشراريب إذا جمعت على اختلاف عدد ألوان الشراريب .
فإننا نضع الألوان لونا لونا في جدول في عرض الصغ على ما في المثال :

جدول جمع الجدول	وهكذا تخطيط المثال في الجدول									
1	من عشرة ألوان									
10	1	جدول الشراريب التي من تسعة ألوان تسعة ألوان								
45	8	1	جدول الشراريب التي من ثمانية ألوان ثمانية ألوان							
120	28	7	1	جدول الشراريب التي من سبعة ألوان سبعة ألوان						
210	56	21	6	1	جدول الشراريب التي من ستة ألوان ستة ألوان					
252	70	35	15	5	1	من خمسة ألوان خمسة ألوان				
210	56	35	20	10	4	1	من أربعة ألوان أربعة ألوان			
120	28	21	15	10	6	3	1	من ثلاثة ألوان ثلاثة ألوان		
45	8	7	6	5	4	3	2	1	من لونين لونين	
10	1	1	1	1	1	1	1	1	من لون لون	
	ع	د	ر	ز	ح	ط	ث	ج	ب	أ

جدول (1)

(مرسوم في ص. 328)

Figure 3: Resolution table for a problem proposed by Mun'im, using combinatorial analysis, which brings us back to the arithmetic triangle. (Djebbar, 1985)

This knowledge was eventually erased when, historically, the name *Pascal's triangle* was imposed and adopted. As we have seen, Pascal was not the first to produce mathematical knowledge on the subject. The mathematical knowledge produced in Europe is certainly important, but it cannot be taken as the origin of all Mathematics.

However, there is also knowledge that did not even remain as part of that considered valid. During the colonial period, several peoples were completely wiped out and, as a result, their knowledge and skills were permanently erased. Take, for example, the numerical knowledge of the Palicures, indigenous peoples who currently live in the Oiapoque River region, in the state of Amapá, and in French Guiana. Despite not having a writing system, the Palicure culture gave rise to a numbering system, which researchers call *number words*.

The Palicures' numerical system is decimal and agglutinative, meaning that each *number*

word is formed by a root “added to a multiplicity of affixes, or morphemes, designating/expressing basic and also sophisticated concepts” (Passes, 2006, p. 254). In addition, “since a number word can be used with a variety of classifiers, modifiers, arithmetic affixes, syntactic affixes and, in the case of ‘one’, gender agreement markers, many Pa’ikwené numerals have more than two hundred forms in everyday conversation” (Passes, 2006, p. 255).

The number words referring to *one* in Pa’ikwené are classified according to categories of animate or inanimate things, *sets*, *fractions*, among others. All are formed from the root *paha*. Table 1 provides some examples.

Table 1: Varieties of *one* pa’ikwené

<p>Animated category <i>units</i>: <i>Paha-v-wi</i> one-animated unit, masculine class <i>Paha-v-rú</i> one-animated unit, feminine class <i>Paha-mpú</i> one-animated unit, dead class</p> <p>Inanimate category <i>units</i>: <i>Paho-ú</i> one-round/square class <i>Paha-t</i> one-cylindrical class <i>Paha-tra</i> class one-extended (linear) <i>Paha-a</i> class one-irregular <i>Paha-kti</i> class one-leaf-shaped <i>Paha-úkú</i> class one-hand (full)</p> <p>Category <i>sets</i>: <i>Paha-brú</i> class one-group <i>Paha-ki</i> class one-tied together <i>Paha-inkú</i> class one-wrapped together <i>Paha-yap</i> class one-in a pot together</p> <p>Category <i>fractions</i>: <i>Paha-bak</i> class one-side <i>Paha-úhri</i> class one-part/piece</p> <p>Category ‘abstractions’: <i>Paha-t</i> class one-abstractions</p> <p>Category <i>series</i>: <i>Paha-i</i> class one-series</p>

Source: Adapted from Passes (2006)

As can be seen, for palicures, the act of quantifying and measuring is not an abstract action, but is related to existential and practical contingencies.

In Pa’ikwené (an Arawak language), you can use numbers to describe social behavior, actions, and states of being. Thus, you can say of a withdrawn or isolated man that he has ‘one-ized’ himself, *Ig pahavwihwé*, or that two individuals have ‘two-ized’ themselves, *Egkis piyanméhwé*, meaning that they have married (Passes, 2006, p. 246, parentheses and emphasis added).

This wealth of knowledge has no place in Mathematics today, considering how it is commonly conceived. The history of palicures is not told; their knowledge and practices have been neglected to such an extent that they are practically considered *non-existent*.

Thus, we can say that dominant power does not only interfere in the political and economic spheres, but also in the forms of knowledge produced and practiced by dominated

peoples, creating a single version of history. Adichie (2019) refers to a *single story*, and it is this definitive and *unique* story that ends up erasing the complexity of human production in Mathematics and other spheres of our societies.

The concept of a universal Mathematics further amplifies prejudices about the mathematical knowledge and practices of other cultures. By defending a single Mathematics, we give local knowledge — the Mathematics produced by Europeans — the status of global knowledge. “Stories matter. Many stories matter. Stories have been used to plunder and slander, but they can also be used to empower and humanize. They can shatter the dignity of a people, but they can also repair that shattered dignity” (Adichie, 2019, p. 16). We therefore believe that history has a central role to play in the quest for redress and a reconfiguration of the way we conceive Mathematics. More than that, we need to rethink the ways in which we teach and learn Mathematics.

We believe that the history of Mathematics, from the perspective presented above, serves as an ally to the field of Mathematics education when it seeks to promote social justice in the curriculum, in teacher training courses, and in the processes of teaching and learning Mathematics. We understand that

History can be one of the paths for reflection in the classroom on the construction of mathematical knowledge based on sociocultural issues, making Mathematics teaching more meaningful for students to learn and grasp mathematical ideas and content. (Oliveira, 2024, p. 30).

Therefore, it is urgent and necessary to rethink the Mathematics curriculum for social justice in non-Eurocentric cultures, promoting their mathematical knowledge and skills in the classroom.

3 The Mathematics curriculum from a social justice perspective and its relationship with the logical-historical movement of mathematical concepts

A possible proposal for rethinking the current Mathematics curriculum is directly related to the logical-historical development of concepts, considering that, when discussing topics involving national reconstruction, social justice, and the role of Mathematics education in the Brazilian context, we understand that, as Mathematics educators, it is necessary to reflect on some issues that are very important to us: 1) What would be the characteristics of a Mathematics curriculum that aims to promote social justice? 2) What is the role of the Mathematics curriculum in a country with such historical inequality? 3) How can the Mathematics curriculum contribute to teacher training and the pursuit of social justice? 4) Is it possible to conceive of a Mathematics curriculum that prioritizes social justice? 5) What should be the role of Mathematics Education in the construction of a Mathematics curriculum that prioritizes social justice, both in basic education and in higher education?

We understand that the answers to these questions necessarily lead us to the study of topics involving: 1) Law n. 10.639/2003, which celebrated its 20th anniversary in January 2023, and its ramifications for Mathematics curriculum in both basic education and undergraduate and graduate Mathematics programs; 2) the decoloniality of the Mathematics curriculum, in the sense of promoting the history of mathematical concepts created by non-Eurocentric peoples; 3) ethnic-racial relations in the context of Mathematics Education and the training of teachers who teach Mathematics; 4) the configuration of structural elements that promote racial equality in Mathematics Education and teacher training; and 5) the outline of a proposal for anti-racist Mathematics Education and the analysis of the role of Mathematics in the struggle for social justice.

In this sense, we start from the assumption that it is only possible to outline a proposal for anti-racist Mathematics education that promotes the struggle for social justice when mathematics educators, that is, all of us, are willing to analyze or further educate our perspectives in depth with regard to scientific and structural racism and the social and gender inequalities that are present in different educational spaces, including basic education schools and universities, especially public ones that train teachers who teach or will teach Mathematics. We are referring more specifically to undergraduate courses in Mathematics and Education, which, after 20 years, have still not included in their work plans mandatory activities or subjects related to the study of Law n. 10,639/2003.

For this reason, in this paper, we will address the relationship between curriculum justice and Mathematics Education, the Mathematics curriculum from the perspective of social justice and its relationship with historical-cultural theory, the possibilities for configuring the decoloniality of the Mathematics curriculum in learning situations that prioritize social justice for non-Eurocentric peoples, final considerations, and references.

3.1 Curriculum justice and Mathematics Education

When referring to the concept of curriculum justice and bearing in mind Law n. 10,639/2003, we are basing our argument on the theoretical work of Ponce and Araújo (2019, p. 1), whose studies indicate that the issue in question involves the need to understand the relationship between “curriculum justice in the 21st century, policies, and the subjects of the curriculum”, as well as neoliberal curriculum policies (BNCC), Brazilian society's disregard for the National Education Plan (2014-2024) over the last ten years, and the concept of curriculum justice.

The authors mentioned also state that, in the 1990s, countries linked to the OECD developed benchmarks for evaluating and comparing educational outcomes, creating the *Programme for International Student Assessment* (PISA). Here,

educational competencies aligned with economic transformations were standardized in order to evaluate them and promote rankings between and within the countries involved. This logic now regulates educational policies, inducing national states to carry out curriculum reforms. (Ponce and Araújo, 2019, p. 3).

In general, these reforms have not considered the participation of teachers in basic education, nor that of social movements that fight daily to combat social injustices. We are referring to the black movement and quilombola and indigenous groups that have constantly drawn our attention to ethnic and racial issues and racism, for example. Thus,

once again, the curriculum stands out as a battleground for political forces on different and opposing sides: the first of these forces is related to those who align themselves with the pursuit of a rationality concerned with efficiency in relation to the development of the current economic system. (Ponce and Araújo, 2019, p. 4)

At the same time, there are those who are part of the second force, because “understand that the school curriculum can and should be designed collectively based on objectives aimed at building a more just society, with social equals respected in their diversity” (Ponce and Araújo, 2019, p. 1048).

In the case of the first aspect, we highlight characteristics that, in our view, are very

worrying: 1) the centralization and prescription of the curriculum; 2) external evaluation “has criteria defined on the basis of competencies geared to the interests of the financial system”; and 3) “the centralization of education funding, in the Brazilian case, coupled with deep cuts in public spending, has been the fuel for the neoliberal machinery in Brazilian school education” (Ponce and Araújo, 2019, p. 1048).

Given these aspects, the authors analyze the current context in which the interests of the financial system are linked to the government, which represents them in its educational policy proposals.

This way of thinking about the curriculum should necessarily integrate the role of Mathematics Education in the Brazilian context, since, in order to combat the ills of social injustice, the Mathematics curriculum must aim to build social justice. In this sense, we agree with Ponce and Araújo (2019, p. 10), who, based on Connell (1997), state:

For curriculum justice, a concept of curriculum is adopted that recognizes the cultural plurality of society, elevating the knowledge of the less privileged beyond folkloric, stereotypical, and fragmented treatment, which does not consider in depth the historical, political, and social mechanisms of formation and exclusion of identities. [...] Curriculum justice is one of the processes of seeking social justice, which is achieved through the school curriculum, valuing its collective nature. It seeks its foundations in significant democratic historical experiences of school education. (Ponce and Araújo, 2019, p. 10).

From this point of view, the Mathematics curriculum should be designed collectively and seek its foundations in the different significant democratic historical experiences that occur in school Mathematics Education. At the same time, the curriculum should not lose sight of the fact that

curriculum justice has three dimensions and can only be conceptualized, understood, and practiced by considering all three. These are: the dimension of *knowledge*, understood as a strategy for producing a dignified existence, which will guide the selection of curriculum content; that of democratic and supportive school *coexistence*, which allows for conflict and divergence, so that humanitarian values can be consolidated and a culture of debate and respect for others can be created; and the *care* for all subjects in the curriculum so that access to the full right to quality social education is made possible, which involves the affirmation of rights, ranging from good public policies for training and hiring teachers that dignify them to the care of protection networks for the most vulnerable, including good conditions in spaces and good use of school time. In this conception, it will be up to schools to cultivate a culture of participation and training (Ponce and Araújo, 2019, p. 12, emphasis added).

In order for mathematical content to align with the assumptions of curriculum justice, we must remember that the field of Mathematics Education is directly related to different areas of knowledge, such as Education, Philosophy, Mathematics, Psychology, Sociology, History, Anthropology, Semiotics, Economics, Epistemology, among others, because, according to Fiorentini and Lorenzato (2006, p. 5), Mathematics Education “it is a practice that involves mastery of specific content (Mathematics) and mastery of pedagogical ideas and processes related to the transmission/assimilation and/or appropriation/construction of school mathematical knowledge”.

Furthermore, the main role of Mathematics Education is directly related to the creation of possibilities that take into account the cultural diversity of civilizations that have produced and continue to produce mathematical knowledge, as well as the different mathematical knowledge historically produced by groups considered non-Eurocentric, including Africans.

In this sense, it is up to all of us, mathematics educators, to consider Mathematics as a tool for intellectual and social formation, which promotes the development of knowledge and pedagogical practices that contribute to human formation (Fiorentini and Lorenzato, 2006).

To this end, we, as mathematics educators who participate in curriculum development and implementation, should not disregard the three dimensions pointed out by Ponce and Araújo (2019) regarding mathematical content: mathematical knowledge; coexistence between different mathematical cultures; and care for all subjects in the curriculum, teachers and students, with special attention to black and indigenous children and young people.

3.2 The Mathematics curriculum from a social justice perspective and its relationship with historical-cultural theory

When studying the Mathematics Education curriculum based on historical-cultural theory, Moura (2017) states that the objectification of the curriculum in pedagogical activity can be established by considering that “the development of the curriculum [has] a formative dimension for those who, as subjects, participate in this complex activity that in some way aims to carry out a social project” (p. 98).

The social project that Moura (2017) refers to has the purpose of humanizing the subjects involved in school education, understood as a means for psychic and human development, not restricted to the acquisition of content or the development of certain skills, since the “curriculum is ideological, which has its political motivations, but our target is precisely to place ourselves as subjects who in some way, consciously or not, contribute to the realization of this purpose” (Moura, 2017, p. 100).

It should also be considered that “curriculum development [also has] a formative dimension for those who, as subjects, participate in this activity that concretizes a conception of society and man that aims to form” (Moura, 2017, p. 100), so that the curriculum is understood as a pedagogical activity. In other words:

What becomes essential in the definition, formulation and execution of a curriculum proposal is what is aimed at with the curriculum, to whom the knowledge considered relevant for its constitution as a subject of a given society is addressed. (...) the way in which the object of knowledge is conceived, whether its historicity is recognized or not and how the role of the subject in relation to this object is understood, is decisive for the organization of school education and the way in which we carry out the pedagogical activity that gives movement to the relationship between teaching and learning (Moura, 2017, p. 101).

Thus, in order to overcome the view that content is detached from our lives, and therefore from the humanization of individuals, there is no denying the importance of teachers and students appropriating the logical-historical movement of the concepts they study. We agree with the author “that learning of content should focus on the processes of signification [...], considering the formative force of understanding the logical-historical development of the concept [...] (Moura, 2017, p. 103).

Thus, the role of the History of Mathematics: 1) represents the link between the causality

of facts and the possibility of creating new definibilities of the concept that allow us to understand the reality studied; 2) can help teachers break with educational practices that disregard the historiographies of Mathematics; 3) prioritizes theoretical thinking in Mathematics teaching (internal and external connections); 4) promotes a Mathematics curriculum that prioritizes social justice, especially for black people, since teachers and students can appropriate the history of mathematical concepts.

In this sense, we agree with Todão (2024) when he states that

the history of Mathematics becomes lighter when we show that Mathematics is a human construct, created and developed by the power of our ancestors, that our black children, teenagers, and adults know that they are descendants of queens, kings, and people who developed Mathematics, that non-black people recognize the enormous African contribution to the development of humanity, demystifying what they have always learned through structural racism and scientific racism. The different forms of racism dehumanize, while true history and representation humanize. (Todão, 2024, p. 37).

In other words, the logical-historical movement of mathematical concepts allows teachers in both basic education and higher education who work in Mathematics degree courses to incorporate Law No. 10,639/03 into their classes in order to decolonize the curriculum and outline a proposal for the establishment of anti-racist Mathematics Education.

3.3 Possibilities for configuring the decoloniality of the Mathematics curriculum in learning situations that prioritize social justice for non-Eurocentric peoples

By arguing that the Mathematics curriculum should adopt a decolonial perspective based on logical-historical development, we affirm the importance of all children and young people, especially Black children, having access to and appropriating the conceptual links between mathematical concepts developed by different civilizations, including African civilization. These conceptual links refer to the connections between concepts, historically modified by different human cultures, among which African culture stands out.

These links can be defined and understood by teacher training students when they come into contact with the historiographies of Mathematics, which indicate the logical-historical movement of mathematical concepts. From Caraça's point of view (1998), these conceptual links were called fundamental concepts of Mathematics.

We suggest that the learning trigger situations (LTS) recommended by Moura (2017) consider: a) the historical movement of the concept, that is, the logical-historical development of the concept being studied; b) the dialectical moments of its formation; and c) the experience of the subjects' participation linked to a reflective-active-explanatory process, measured by the individual-group-class relational dynamics.

We can cite as an example the concept of weights and measures studied by Silva (2004), which is directly related to the human needs of all social groups, the political power of different civilizations, the creation of non-standardized and standardized measures, attempts to unify measurement systems, and the relationship between measurement and social justice, among other aspects. In this sense,

history reveals that the first nomads became sedentary and built the first cities around 6,500 BC, on the banks of the Tigris and Euphrates rivers in the Middle East, and around 5,000 BC, on the banks of the Nile River in North Africa. It was in this part of the world that the oldest known civilization was born, and

after developing pottery, copper and bronze metallurgy, it discovered and perfected various technologies, starting with agricultural irrigation, work planning, the first analyses of the universe, the oldest mythology, the principles of Mathematics and algebra, and later, the first astronomy and the first writing, and finally, the first literary tradition, which profoundly transformed the way men thought and acted, starting with the enactment of laws and the dissemination of scientific advances. (Silva, 2004, p. 39).

The author mentioned above demonstrates that African countries have implemented mathematical principles, which we call conceptual links (internal and external). In this context, it is essential that, when teaching the concept of measurement, teachers design and develop Learning Trigger Situations (SDA) in the classroom that use the conceptual links between discrete and continuous quantities as a starting point. These links underpin the concept of fractions, as illustrated by the SDA Working with *Mother Earth*, developed by Moura et al. (2000) and shown in Table 2.

Table 2: SDA Working with *Mother Earth*

Working with Mother Earth

Objective: To organize our learning process of the concept of fractions, studying one of the four stages involved in the construction of this concept: the opposition between the part of nature that is organized into natural units and the part that is continuous; the practice of geometrizing the earth; the idea of measurement; and the history of a working tool (Lima and Moisés, 1998).

Conceptual links: Magnitudes (continuous and discrete) and Measurement

Triggering problem: Since the Earth does not come in lots or portions, that is, it is not naturally organized into units, humans had to invent a way to divide it into private family properties. This is what the ancient Egyptians did. The shape they adopted to divide their land was rectangular.

However, an unexpected problem soon arose: every year, the Nile floods covered the divided land, erasing the division marks. In addition, the river flooded many portions, reducing the size of the plots.

1) Imagine that you are an employee of the Pharaoh in charge of overseeing the distribution of land.

After a flood of the Nile, you receive a visit from families who want to discuss the return of their land.

- a) What problem do the families present to you? (Write the problem in the form of a simple, direct question — using language appropriate to the historical context).
- b) And for you, a modern student living in the 21st century, what is the problem? (Write the problem as a simple, direct question – using language appropriate to the modern context).
- c) Now rewrite the two problems as one, using only mathematical language, i.e., using only mathematical words.
- d) How do you count an amount of land?
- e) How can we get rid of the illusion of unity?
- f) How can we numerate quantities that are not presented in natural units?
- g) How can we “count” the amount of land each family has?
- h) What is the first step we should take when we want to numerate quantities that are not organized into natural units?

Source: Moura *et al.* (2000)

When dealing with an SDA that takes as its starting point reflections on our *Mother Earth*, we are problematizing some social issues that are at the heart of social injustices in Brazil, considering that enslaved peoples worked hard on the land and, from the moment they were considered free, were evicted from the farms. They were left without land and without work.

It is necessary to draw attention to the fact that 56% of the Brazilian population is black, and as educators, we need to think about an anti-racist Mathematics Education proposal (Sousa, 2024). We argue that national reconstruction in this country will only be possible when there is social justice and, consequently, curriculum justice based on the humanization of all of us through mathematical concepts.

In this sense, the role of Mathematics Education must be rethought so that scientific racism and, consequently, the Eurocentric Mathematics that permeates school curriculum give way to Law n. 10,639/2003. This law requires teachers in basic education and universities to focus on developing what we are calling SDA, which promotes reflection on Afro-Brazilian historical issues and ethnic-racial relations.

That is why we are advocating the design of a curriculum proposal based on the logical-historical movement. Here, we can delve deeper into the history of mathematical concepts and realize that their conceptual links (internal and external) came from African countries. It is no wonder that authors of historiography refer to these links as mathematical principles, or even fundamental concepts of Mathematics, as we indicate in SDA *Working with Mother Earth*. In this specific case, we are suggesting that students appropriate the conceptual links of magnitude (discrete and continuous) and measurement, which will contribute to reflections on issues related to the problems of the Earth experienced by different social groups, including black people in Brazil.

4 Mathematical Education, Curriculum (In)Justice, and the (un)told History of Mathematics

Brilliantly, Zaqueu Vieira Oliveira and Maria do Carmo de Sousa presented their thoughts in their respective speeches, drawing attention to what they consider essential, such as the role of Mathematics Education in the struggle for social justice in the current Brazilian scenario, which is one of reconstruction. And, as challenging as it may be to present considerations on these powerful and necessary speeches, I will attempt to do so, based on a debate on the curriculum.

In my doctoral thesis (Taveira and Peralta, 2024), I have discussed a topic that has no tradition whatsoever in discussions about Mathematics Education curriculum: curriculum justice (Taveira, 2024). Based mainly on Jurjo Torres Santomé (2013) and Connell¹ (1993), I seek to defend the need for Mathematics Education, when addressing curriculum issues, to include discussions on Social Justice among its core concerns. This approach follows the movement that has recently taken hold in Brazilian Mathematics Education by discussing *Mathematics Education for/by/through Social Justice*, which has its main foundation in the writings of Eric Gutstein. For Santomé (2013, p. 9),

curriculum justice is the result of analyzing the curriculum that is developed, implemented, evaluated, and investigated, taking into account the extent to which everything that is decided and done in the classroom respects and meets the needs and urgent demands of all social groups.

For Connell (1993), questioning the principles on which we could attempt to understand a curriculum committed to social justice, “we then move on to suggest three principles: (1) The interests of the less favored; (2) Participation and common schooling; and (3) The historical production of equality” (Taveira, 2024, p. 3).

¹ Robert William Connell is Raewyn Connell's dead name. However, the dead name still appears in original publications that have not been ratified.

In this scenario, considering that Santomé (2013) understands Curriculum Justice, in large part, as the knowledge necessary for a given era, and that Connell (1993) presents three principles of Curriculum Justice — the third of which seeks to reduce the tensions that exist between the first two — I have taken these issues to ground my understanding of the debate on Curriculum Justice that I intend to conduct in Mathematics Education.

However, I have noticed that people concerned with discussing *Mathematical Education for Social Justice* — I will use this expression — do not admit an intelligible understanding of Social Justice. Gutstein (2006), for example, bases his argument primarily on Rawls' (2008) conception of justice, which is universalist and based on the distributive paradigm, that is, the thinking that has dominated political philosophy discussing justice for over 150 years (Fraser, 2002).

Thus, taking as theoretical basis the writings of Santomé (2013) and Connell (1993) and paying attention to one of Nancy Fraser's (2014) lessons on justice, which states that

the strategy of approaching justice negatively, through injustice, is powerful and fruitful. *Pace* Plato, we do not need to know what justice is to recognize that something is wrong. Rather, what we need is to sharpen our sense of injustice and cut through the veils of ideology. When we look at what is wrong, we need to determine why it happened and how a similar situation can become just (Fraser, 2014, p. 275, emphasis added).

I propose that we do not treat issues of curriculum justice as such, but rather as curriculum injustice. In this panel, I will seek to show how Zaqueu Vieira Oliveira and Maria do Carmo de Sousa denounced and presented possible ways of correcting the curriculum injustices they diagnosed in Mathematics Education.

First of all, allow me to clarify what I mean by curriculum injustice. Considering that any curriculum discussion should be concerned with formative processes, and based on the notes I make about the references of Santomé (2013) and Connell (1993), in which both authors present, in their theories on Curriculum Justice, a concern with inconsistencies — Santomé regarding the knowledge studied in a given historical period and Connell regarding the reduction of inconsistencies that generate tensions between his first two principles of Curriculum Justice — I propose that we understand Curriculum Injustice as the inconsistencies present in educational processes.

Thus, with a well-defined understanding, I will now point out how Zaqueu Vieira Oliveira and Maria do Carmo de Sousa very well denounce curriculum injustices in Mathematics Education. However, I emphasize that the educational process to which I refer in my considerations is that related to the initial training of Mathematics teachers, as we share this same concern in our professional and research activities.

Professor Zaqueu Vieira Oliveira begins his explanation very well by challenging an idea that is strongly present in the social consciousness: Mathematics is knowledge. In the professor's own words, it is

a divine activity unique to a select group of brilliant individuals [...] [given that] This perception brings us face to face with a widely held and accepted view that Mathematics is universal and unique, produced in a linear and neutral way (Oliveira, 2024, p. 3).

In his speech, he gives us a good example, present in discussions of the history of

Mathematics, which, as we have been told, is full of injustices. He shows how the arithmetic triangle, commonly associated with the French mathematician Blaise Pascal in the 17th century, had already been proven by others long before Pascal presented it in his classic work *Traité du triangle arithmétique*, in 1665, such as the Chinese mathematician Jiǎ Xiàn, during the 11th century; the Iraqi mathematician Al-Samaw'al ibn Yaḥyā al-Maghribī, in the 12th century; and the Andalusian mathematician Ibn Mun'im, in the 13th century.

Although we already have discussions and investigations in the history of Mathematics that show that, long before Pascal, other mathematicians who are not part of the Global North had already presented the result attributed to him, the idea that this classic result of Mathematics is attributed to Pascal still persists in Mathematics degree courses.

In addition to this curriculum injustice in the initial training process of undergraduate Mathematics courses, Zaqueu Oliveira also discusses, citing as an example the case of the numerical knowledge of the Palicures — indigenous peoples living in the region of the Oiapoque River, in the state of Amapá, and French Guiana — how, during the colonial period, “various peoples were entirely wiped out and, as a result, their knowledge and skills were also definitively erased” (as written in previous section). This phenomenon also occurs in the initial training process in Mathematics degrees, as the history of the Palicure peoples is not told — especially in Brazil, where such peoples still exist — as if their knowledge and skills were practically non-existent.

By denouncing the inconsistencies present in the history of Mathematics that we were taught and how certain knowledge of traditional peoples was wiped out by the processes of colonization — and even though it still exists, it does not appear as part of the training agenda in Mathematics degree courses — Zaqueu Oliveira rightly denounces, illustrates, and demonstrates a curriculum injustice in the initial training process of Mathematics teachers.

Maria do Carmo de Sousa, in turn, understands that discussing national reconstruction, social justice, and the role of Mathematics Education in Brazil involves several issues and themes. Among these, I will highlight Law n. 10,639, of January 9, 2003, and the proposal for anti-racist Mathematics Education.

Based on Ponce² and Araújo (2019), who also draw on Robert Connell's writings to present three dimensions of curriculum justice, namely: the dimension of knowledge, the dimension of coexistence, and the dimension of care for all subjects in the curriculum, Professor Maria do Carmo understands that the main role of Mathematics Education is related to offering educational opportunities that consider the cultural diversity of civilizations that have produced and continue to produce mathematical knowledge, in addition to considering the different mathematical knowledge that has been historically produced by groups that escape the Eurocentric perspective, mainly groups from the African continent.

Focusing on a historical-cultural perspective, the teacher understands that the history of Mathematics is a possible means of promoting curriculum justice in educational processes involving Mathematics, including the initial training of Mathematics teachers. In the professor's own words, a logical-historical perspective on mathematical concepts, derived from discussions of the history of Mathematics that has not been told to us, would make it possible to offer formative experiences in the Bachelor's Degree in Mathematics that would enable Mathematics teachers in basic education to include “Law n. 10,639/03, in order to decolonize the curriculum and outline a proposal for the establishment of anti-racist Mathematics Education” (as written in the previous section).

² Professor Branca Jurema Ponce has been conducting studies and research on Curriculum Justice at the Pontifical Catholic University of São Paulo, based mainly on the work of Jurjo Torres Santomé and Robert William Connell.

Presenting a practical example of how it would be possible to put into practice what she advocates, Maria do Carmo de Sousa offers a situation that triggers learning, considering essential elements of how to work from a non-Eurocentric perspective, with a view to practicing anti-racist Mathematics Education.

Thus, if there is no adequate training in the Mathematics Degree Program to enable compliance with Law n. 10.639/2003, in a country where the majority of the population is black and racism still prevails in Brazilian social ideology, Maria do Carmo de Sousa shows us how the inconsistency related to the absence of adequate training in the initial training of Mathematics teachers that allows them to work on the contributions of groups — such as those from African countries — to the development of mathematical knowledge, and not only those from Europe, constitutes a curriculum injustice in the training processes carried out in Mathematics degree courses.

As an alternative to this curriculum injustice, Professor Maria do Carmo proposes anti-racist Mathematics Education as a way of confronting scientific racism, which still resonates in Eurocentric Mathematics in various Mathematics curriculum, both in Mathematics degree courses and in school curriculum. She draws attention to Afro-Brazilian historical issues and ethnic-racial relations, given the configuration of the Brazilian population. In my view, from Maria do Carmo de Sousa's perspective, the role of Mathematics Education in national reconstruction is primarily anti-racist.

Therefore, the curriculum injustices pointed out by Professor Zaqueu and Professor Maria do Carmo, in terms of the training process that takes place in Mathematics degree courses, corroborate the professional practices — of people who are in this initial training process — who do not consider the (un)told history of Mathematics and that this phenomenon, in turn, feeds the idea, strongly present in the social imagination, of mathematical knowledge as neutral — as cited by Zaqueu Vieira Oliveira — in addition to being an obstacle to pedagogical practices in Mathematics that recognize and highlight Afro-Brazilian and African history and culture — as cited by Maria do Carmo de Sousa.

As final considerations, I turn to Nancy Fraser's (2022) two-dimensional perspective of social justice to argue, in terms of educational processes, that it is not enough to recognize the validity, relevance, and necessity of addressing content and themes related to what has been defended here in initial training. It is also necessary that spaces — for this training to take place — be made available, aligning recognition [of topics/themes] if, and only if, there is redistribution [of training spaces] (Taveira, 2023).

5 Final words

As a final note, we would like to highlight the fruitfulness of the discussions raised in this text for the initial training of Mathematics teachers, given that this process offers privileged spaces for discussion and formative experiences related to the history of Mathematics, an element that was so touched upon in the considerations presented. The history of Mathematics, as we have seen, has the power to produce, reproduce, and reverberate curriculum injustices in various training processes, especially in Mathematics Education, as we have seen throughout this reflection.

This paradigm, which still holds true, may continue for much longer. We believe that it is up to us, teachers, mathematicians, to be concerned with our own training, with the training of those we are training, with the training of those who will be trained, with those we are training, and thus, for years to come.

In a country so marked by cultural diversity, maintaining discussions on the history of Mathematics in Mathematics degree programs that focus solely on a Eurocentric history of

Mathematics not only reverberates curriculum injustices in the current educational process, but also contributes to maintaining the idea of mathematical knowledge as linear and neutral in the social consciousness. Furthermore, such action contributes to the failure to comply with national laws and historical debts which, in line with the Brazilian reality, require recognition of the history and contributions of African and Afro-Brazilian history as constitutive of our history — the history of Brazil and the Brazilian people.

It is certain that any contributions that Mathematics Education can offer to the National Reconstruction movement, concerned with social justice, run through the themes, perspectives, and defenses presented and discussed here.

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The authors declare that there are no conflicts of interest that could influence the results of the research presented in the article.

Data Availability Statement

This article was prepared based on a theoretical study, therefore, there is no data to be made available.

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