



Are We Experiencing a Decolonial Turn on Brazilian Scientific Education?

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Abstract

In roughly seventy years of existence in Brazil, research in science teaching has shifted its theoretical and methodological frameworks. As an effect of these changes, over the decades there have been some booms in publications focusing on new research approaches in this area. Glancing at Brazilian scientific till mid-2021, we suggest the emergence of another wave in the sea of science education, attracted by discussions associated with the impacts of colonization on education. In this work, we first present part of the polyphonic theorization related to resistance to colonization and highlight relevant points of this dialogue for our area. Later, based on bibliographical research, we show the increase in the number of articles related to these perspectives published in national journals by the science teaching community. In addition, we brought events that probably contributed to catalyze the income of this theoretical framework into the area in Brazil. We raised the hypothesis that the year of 2004 was the starting point of the introduction of decolonial framework in Brazilian science education and the year of 2019 as the turning point for anchoring a crucial movement for the promotion of social justice in science teaching in the country.

Keywords: coloniality, scientific education, decolonial turn

Estariamos Vivenciando uma Virada Decolonial na Educação em Ciências Brasileira?

Resumo

Em cerca de setenta anos de existência no Brasil, a pesquisa em ensino de ciências tem se metamorfoseado teórico-metodologicamente. Como efeito dessas transições, ao longo das décadas houve alguns booms de publicações com foco em novas abordagens de investigação nessa área. Olhando para a produção científica brasileira até meados de 2021, sugerimos o avanço de outra onda no mar da educação científica, atraída por discussões associadas aos impactos da colonização para a educação. Neste trabalho, primeiramente apresentamos parte da teorização polifônica relacionada à resistência da colonização e destacamos pontos relevantes desse diálogo para nossa área. Posteriormente, com base em uma pesquisa bibliográfica, mostramos o aumento do número de artigos ligados a essas perspectivas publicados em periódicos nacionais pela comunidade de ensino de ciências. Complementarmente trouxemos acontecimentos que provavelmente contribuíram para catalisar o ingresso deste referencial teórico para a área no Brasil. Estabelecemos a hipótese de que o marco para a introdução do referencial decolonial no ensino de ciências brasileiro ocorreu em 2004 e que o ano de 2019 tornou-se um ponto de viragem para o ancoramento de um movimento crucial para a promoção de justiça social no ensino de ciências no país.

Palavras-chave: colonialidade, educação científica, virada decolonial

¿Estamos Viviendo un Giro Decolonial en la Enseñanza de las Ciencias en Brasil?

Resumen

En cerca de setenta años de existencia en Brasil, la investigación en la enseñanza de las ciencias se ha metamorfoseado teórica y metodológicamente. Como efecto de estas transiciones, a lo largo de las décadas ha habido un auge de publicaciones centradas en nuevos enfoques de investigación en este ámbito. Mirando la producción científica brasileña hasta mediados de 2021, sugerimos el avance de otra ola en el mar de la educación científica, atraída por discusiones asociadas a los impactos de la colonización para la educación. En este trabajo, presentamos primero parte de la teorización polifónica relacionada con la resistencia a la colonización y destacamos puntos relevantes de este diálogo para nuestra área. Posteriormente, con base en una investigación bibliográfica, mostramos el aumento en el número de artículos relacionados con estas perspectivas publicados en revistas nacionales por parte de la comunidad de pesquisa en ciencias. Además, trajimos eventos que probablemente contribuyeron a catalizar la entrada de este marco teórico en el área en Brasil. Planteamos la hipótesis de que el año 2004 se estableció como el hito inicial para la introducción del referencial decolonial en la educación científica brasileña y el año 2019 como el punto de inflexión para el anclaje de un movimiento crucial para la promoción de la justicia social en la educación científica en el país.

Palabras clave: colonialidad, educación científica, giro decolonial

Introduction

As a consequence of the cultural hegemony built throughout the centuries by Europe over its former colonies and the subsequent establishment of the United States as an imperialist power, Brazilian research in science teaching has been marked by theoretical, methodological, and political influences from the Global North since its inception (Cassiani, 2021; Dutra et al., 2019; Krasilchik, 2000). History indicates that European politics, economy, and culture have been celebrated since the advent of modern colonization, due to administrative impositions and rhetorical seduction of non-European groups regarding an evolutionary apogee of humanity that would have occurred in Europe in the 18th century.

Despite the liberation of most nations in the Global South, the imitation of modern European standards lingered. The prolonged subservience of colonized territories was possible due to discursive strategies that, for centuries, overvalued European accomplishments. This hierarchy endorsed the plunder, enslavement, epistemicide and genocide that occurred in the Americas.

Throughout the development of research in science education, the economic and social conditions of students for learning science gained prominence (A. M. Martins & Lima Jr, 2020; Garcia-Silva & Lima Jr, 2020; Lima Jr & Fraga Jr, 2021) bringing other nuances to the field once centered on cognitivism (Queiroz, 2018). Socioeconomic debates in science education have currently been enriched with the perception of the relevance of the cultural specificities of students from historically invisible groups for their integration in science classes (Aikenhead & Lima, 2009; Carter, 2017).

In westernized societies, learning and involvement with scientific culture can enable the entry of peripheral citizens into prestigious career paths. The appropriation of science can also strengthen the participation of minorities in struggles for social rights (Aikenhead & Lima, 2009). Unfortunately, despite the benefits of acquiring cultural capital, access to symbolic goods produced by the natural sciences does not happen in an equivalent way for each social group. The literature indicates that students whose home culture significantly distances itself from scientific culture tend to be marginalized in science classes (Aikenhead & Lima, 2009; Carter, 2017). Meanwhile, the increased access of peripheral citizens to school science has revealed epistemological and ontological gaps in school and academic practices (Benite et al., 2017). Such gaps are considered consequences of the geopolitics of knowledge established with the invasion of the Americas.

The colonial enterprise is considered the key point for the establishment of modern western science, for the strengthening of capitalism, for the socio-historical construction of Latin American countries and for the delineation of contemporary local and global disputes (Mignolo & Walsh, 2018). Even though the aforementioned themes are strongly related to the teaching of natural sciences, theoretical perspectives of resistance to colonization emerged recently in Brazilian research in science education (Dutra et al., 2019; Walsh et al., 2018). Although the discussion can still be considered as a novelty, we perceive an increasing need for counter-hegemonic perspectives that will liberate Brazilian research in science education from its colonial influences (do Nascimento & Gouvêa, 2020; Dutra et al., 2019).

This trend prompted us to question: **Are we experiencing a decolonial turn in Brazilian science education?** To answer the question, we review the literature drawing on quantitative and qualitative information obtained from journal indexers, the occurrence of discussions at events in the area and the release of books on the subject in the last five years. In the next sections, we will briefly overview the resistance to colonization in order to locate the various trends at stake. Next, we expose the method chosen to carry out our literature review. In the topic dedicated to the results and discussions, we list data on the productions found in the area. We do also mention relevant occurrences for the establishment of such counter-hegemonic theories. Based on our analyses, we suggest the year 2004 as a milestone in the insertion of the critical debate on colonization in the area of science teaching/education in Brazil and the year 2019 as a turning point for the theme, probably stimulated by the actions of researchers and research groups from the southeast, south and northeast regions.

Multiple Ways of Contesting Colonialism

The violent invasion of the Global South by European colonizers was followed by acts of resistance. It is important to emphasize that, despite having occurred on a global scale over a very long period and with striking similarities regarding the forms of violence employed, the colonial exploitation of territories and the domination of people in Africa, America and Asia were very different from each other (P. H. Martins, 2019).

The recognition of such singularities helps us to understand the reason why political, economic, and sociocultural analyses of colonialism tend to be as polyphonic and diverse as the ways of breaking with colonial rule.

There are, in the literature, non-consensual categories for naming the counter-hegemonic manifestations against the colonial enterprise. These categories are either related to chronology, theoretical influences, units of analysis and degrees of rupture with the *status quo* (Ballestrin, 2017; Miglievich, 2016). Some authors argue that carrying out such academic divisions would mean sticking to the *mode of operation* of the criticized system. However, expressing oneself academically against colonialism does not necessarily configure a paradox. On the contrary, we prefer to consider such an effort as productive as long as they critically orient our perspectives and actions.

Since they are irreducible to each other, different theoretical perspectives should be distinguished. However, if they become stronger together, these distinctions become less important. In general, counter-hegemonic theorizations against colonialism regard “a way of critically theorizing the colonial legacies left by European expansion in those regions of the world that have been annexed, economically and culturally, to the modern colonial world-system since the 16th century” (Castro-Gómez, 2021, p. 13, our translation). In this paper, we use the word “decolonial” to address these theoretical productions as a whole. We understand that the act of grouping different counter-hegemonic perspectives such as anti-imperialist, post-colonialist, decolonial and countercolonial (pt., *contracolonial*), does not ignore their specific needs, assumptions, and experiences. Also, due to their proximity, it is not uncommon, for example, to find texts from different areas that present a certain eclecticism by appropriating one or more directions in their discussions. Anyway, recognizing overlaps between theoretical stances does not imply underestimating the gaps between them. In order to better conduct the discussion that will follow, in order to avoid ambiguities that could be raised from the use of the word “decolonial”, we prefer to use the expression “*perspectives of resistance to colonization*”. Finally, even though the debates have a critical character, we avoid the expression “Critical Theories”, to escape from inappropriate parallels with the Frankfurt School.

Next, we bring a panoramic overview of some of the theoretical perspectives of resistance to colonization. Furthermore, even though our presentation unfolds according to the Western notion of time, the order chosen to present the movements does not intend to be strictly chronological, as many of these manifestations emerged in very close historical contexts.

Anti-colonial and Anti-imperialist Demonstrations

From the context of Abya Yala, the energy of resistance and de-colonial attitude (Dias & Abreu, 2020) go back to the beginning of colonization (Mignolo & Walsh, 2018). We classify here manuscripts prior to the influence of post-structuralism and Cultural Studies as anti-colonial (Ballestrin, 2017; Miglievich, 2016). Thus, the first

written anti-colonial manifestations appear in texts dating from the 17th century, such as *Nueva corónica y buen gobierno* (1616), by the indigenous Wama Poma de Ayala and *Thoughts and sentiments on the evil of slavery* (1787), by Otabbah Cugoano, a former enslaved man. Such written records also revealed in the colonial period the concerns of local populations regarding the predatory European contact (Ballestrin, 2013; Mignolo, 2005).

The periods that follow take on very specific contours, even within the same continent. In the Americas, at the same time that revolutionary or independence processes unfolded from the 19th century on, mainly due to actions orchestrated by native elites, interested in changing local power (to be able to capture a larger fraction of the privileges), with principles aligned the metropolises and uncompromised with the demands of marginalized social groups, the United States emerged as another center of influence for the newly created nation-states (later the Soviet Union would share this position).

Despite counter-hegemonic initiatives, the legal ending of formal colonial exploitation had limited effects. Signed international agreements did not reach the core of colonial relations, whose effects have been preserved until the present day in bonds of economic, cultural, and political dependence either with Europe or the United States.

To continue this effervescent journey, it is worth recovering a tenuous distinction between colonialism and imperialism. In colonialism, the subjugation of local populations occurs through territorial occupation. Instead, when it comes to US imperialism, sovereignty and control over other territories are exercised even indirectly, without the physical and proper occupation of the dominated territory. When we consider the proximity between colonialism and imperialism, we note that the first is constitutive of the second (Mignolo & Walsh, 2018).

Distinguishing these terms is important to address how changing international relations contributed to reframe social struggles in the Global South between the 20th and 21st centuries. Acts of resistance aimed against the prevalence of the British Empire in Eurasia and North Africa, as well as the United States in the Americas, emerged worldwide. Bolivarianism, for instance, played an important role in resisting the international subjugation of Hispanic America (Mignolo, 2008).

Anti-colonial achievements produced concrete results, such as the decolonization of several African territories through means of popular struggles. However, for most remaining colonies, the end of administrative and military dominance occurred only after the second World War, to the benefit of central countries, which preferred strategically to abdicate the territories of the Global South in order to contain German expansionism (Cardina, 2010).

Regarding theoretical elaborations, the 1950s marked the flourishing of important productions, questioning the economic, social, and cultural marks left by the European invasions on Latin American, Asian, and African populations and nations (Ballestrin, 2017). From Latin America emerged, for example, the dependency theory

and the philosophy of liberation (Ballestrin, 2013). In turn, from the African and Caribbean context, works such as *Discourse on colonialism*, by Aimé Césaire (1955); *The world falls apart*, by Chinua Achebe (1958), *The Wretched of the Earth*, by Frantz Fanon (1968) and *The Colonizer and the Colonized*, by Albert Memmi (1967) (Ashcroft et al., 2003) offered “a keen insight into the lives of those whose identity and culture were transformed by colonialism” (Bonnici, 2005, p. 11, our translation). Such books inaugurate the theoretical ground for contemporary resistance to colonization. We consider them as “anticolonial literature” (Miglievich, 2016), but they might also be classified as “postcolonial” (Ballestrin, 2013).

Postcolonial Contributions and the Latin American Decolonial Emergence

The readings of Foucault and Derrida greatly influenced propositions understood as postcolonial (Miglievich-Ribeiro, 2014). Based on these authors, colonialism ceased to be framed as just an economic and political regime. The epistemic dimension of colonialism was highlighted as an important tool for establishing and maintaining colonial domination beyond the international agreements of formal independence. This epistemic dimension of colonialism is manifest in the role played by superstructural elements such as knowledge, culture, and subjectivity in contemporary resistance to colonialism (Castro-Gómez, 2021).

The term postcolonial brings together multiple meanings (cf. Ballestrin, 2013; Carter, 2012), which we will not delve into. Postcolonial is associated with theorizations about identity, difference, hybridity, and ambivalence (Carter, 2012) found in intellectuals such as Edward Said, Homi K. Bhabha, Ella Shohat, Stuart Hall, Paul Gilroy, from the migratory diaspora and linked to academies in the Anglo-Saxon world.

The book *Orientalism*, by Edward Said, is considered the inaugural landmark of the canonical post-colonialist phase (Ballestrin, 2017; Castro-Gómez, 2021), because Said “made clear the ineluctable link between knowledge and power” (Castro-Gómez, 2021, p. 31, our translation) when reflecting on the role of European literature and human sciences in the stigmatization of the *East*. By analyzing the disciplines of the field *Orientalism*, the author demonstrated how the concept of Orientalism “constitutes a discourse of the West about the East that has both the power to justify Western domination and the possibility of being used as a strategy of military domination” (Macedo, 2004, p. 118, our translation). On discourse and power, Tabet et al (2016, p. 1, our translation) summarize:

(...) discourse is the use of language as a social practice (...) it contributes to the construction of social identities, systems of knowledge and beliefs (...) institutions, through discursive genres, produce, legitimize, or naturalize their values and power relations.

Thus, mentions of East and West are not only related to places or geographic positions, but to principles for classifying and categorizing societies (Western/Non-Western); for creating images that verbally and visually represent people, places, cultures;

and for the production of standards of comparison and *rankings* between societies and cultures (Hall, 1993), which naturally place the West as different from the East and, for having advanced in the evolutionary line of humanity, it has become the oasis in which non-Westerners should mirror themselves.

The postcolonial critique made it possible to go beyond the explicit fact of the occupation of territories and the spoils of colonies by revealing the cultural and epistemic dimension of the colonial enterprise. It uncovered how other levels of the structure of domination in the colonies had been produced, exposing how Western narratives about the Orient became effective instruments of colonial power. Non-European societies, people, places, cultures, verbally and visually represented by Europeans, based on an excluding binary logic, produced Eurocentric standards of comparison that became tools for the hegemony of the moderns (Carter, 2012; Macedo, 2004).

Not only European cultural products were put to the test by postcolonial critique, but also the discourse of social sciences produced at the former colonies. In India, for instance, Ranajit Guha, Patha Chatterjee and Dipesh Chakrabarty constituted the *Subaltern Studies Group* (Aliaga, 2020), which inserted the concept of subalternity, based on a culturalist reading of Gramsci, in South Asia. As subalternity is not understood as a fixed identity (do Nascimento Silva & Oliveira, 2018), this group has given credit, autonomy, and power to the peasant non-elite through the construction of a historiography that considered their voices (do Nascimento Silva & Oliveira, 2018; Legg, 2013).

The Indian feminist Gayatri Spivak, who interacted with the Subaltern Studies Group, is also highlighted in the postcolonial critique, mainly with the writing “Can the subaltern speak?” (Spivak, 2010). In it, the literality of the speech act is not what is questioned. Will the voice of the subaltern be heard in a colonial and racist society? (Kilomba, 2019). Now, if the subordinate speaks (and the dialogue takes place), also sharing a hegemonic place, his condition of subalternity vanishes.

Gayatri Spivak is credited with bringing Americanists and Latin American intellectuals together in the United States with the ideas of the South Asian Subaltern Studies Group. In 1992, thinkers linked to Latin America created a movement analogous to the Indian one: the Latin American Group of Subaltern Studies (Aguiar, 2016; Ballestrin, 2013): “The group discussed plural societies, inferiorized by European thought, exoticized in contrast to developed societies” (Aguiar, 2016, p. 283).

We mark the influence of researchers for the Latin American Group of Subaltern Studies, but we do not place it as a mere extension of Indian work, as Latin American intellectuals draw on genuine local productions in human sciences, such as Liberation Theology/Philosophy and Dependency Theory (Mignolo, 2008).

As the Latin American Subaltern Studies Group developed, members such as Walter Mignolo and Ramón Grosfoguel were disaffected. Mignolo, for example, drew attention to the precedence of the invasion of America, westernism, as a landmark of the violence of the establishment of the modern colonial scheme and, consequently, of

orientalism (Castro-Gómez, 2021). Grosfoguel was critical of the use of Eurocentric references for the critique of Eurocentrism made by the group that had inspired them (Ballestrin, 2013). There was an eagerness to propose a distinct critique, i.e., a critique of Eurocentrism that was inspired by the thinking of those who were historically marginalized. These factors led to a redirection of postcolonial criticism in the subcontinent, the emergence of decolonial perspectives and the breakdown of the Group in the late 1990s.

The Group's activities ended in 1998, but new meetings, publications, and dialogues between intellectuals from different countries led to an "epistemological movement of critical and utopian renewal of the social sciences in Latin America in the 21st century, with the radicalization of the postcolonial argument in the continent" (Ballestrin, 2013, p. 89). Thus, the decolonial debate in Latin America was shaped with the creation of the so-called Modernity/Coloniality Collective (Ballestrin, 2013; Castro-Gómez, 2005).

The Modernity/Coloniality Collective and the Decolonial Turn

Modernity, the target of the deconstructive analysis of the Modernity/Coloniality Collective, means many things and has many different markers (Bauman, 2021). In *The Consequences of Modernity*, Anthony Giddens (1991) answers the question "What is modernity?" defining it as changes in lifestyle that took place very quickly, involving the entire planet, based on the institutional dimensions of industrialism, capitalism, surveillance, and military power that began in Europe in the 17th century. Another way of approaching Modernity is through events such as the "taking of Constantinople by the Turks, the invention of the press by Gutenberg, the discovery of America... [the] Protestant Reformation (...)" (Chassot, 2019, p. 46, our translation) often listed as landmarks of the Modern Age.

The two above ways of characterizing Modernity share the fact of associating it with intra-European life. The analysis of the Modernity/Coloniality Collective points out that disregarding the invasion of America for the constitution of the history of Modernity becomes an analytical approach "not only incomplete, but ideological" (Castro-Gómez, 2005, p. 83, our translation).

Modern Europe, since 1492, will use the conquest of Latin America (since North America only enters the game in the 17th century) as a springboard to take a decisive "comparative advantage" in relation to its former antagonistic cultures (Turkish-Muslim etc.). Its superiority will be, to a great extent, the result of the accumulation of wealth, knowledge, experience, etc., which it will accumulate since the conquest of Latin America. (Dussel, 2005, p. 28, our translation)

"Modern superiority" was established in two phases (Castro-Gómez, 2021). The first one took place with the conquest of overseas territories and with the colonizer-colonized domination. The coercion of Europeans over the bodies and minds of other peoples was structured by the idea of race, a mental construction of vertical categorization

with the purpose of dominating social groups, established in a certain historical time (Almeida, 2020). After inventing the “Indian” and “Black” racialized identities, the “European” identity was constituted and disseminated with colonial expansion. This also legitimized the elaboration of the Eurocentric perspective of knowledge (Quijano, 2005) which had its apogee in the Enlightenment. The second phase of modern European superiority, self-proclaimed as the epistemological and ontological center of the world, is characterized by the structural and superstructural transformations that flourished in its province.

The most popular edition of the history of Modernity has been done for centuries, obscuring the relevance of coloniality for the establishment of the modern *ethos*. From the decolonial turn, which has connections with “the linguistic turn, generated in the wake of debates on the postmodern, on poststructuralism and on colonial studies” (P. H. Martins, 2019, p. 3, our translation), the parties cut from official history were rescued and reexamined, allowing us to see that modernity was only constituted from coloniality (Mignolo & Walsh, 2018).

The deconstruction of the European epic also revealed the modern power project of erasing local ways of being and thinking in order to exploit the populations of the Global South. The decolonial turn as a theoretical and practical, political, and epistemological resistance movement has as its fundamental constituents in the de-colonial attitude and de-colonial reason (Ballestrin, 2013). About the de-colonial option Mignolo declares:

The de-colonial option is epistemic, that is, it detaches itself from the genuine foundations of Western concepts and the accumulation of knowledge. By epistemic disengagement I do not mean abandonment or ignorance of what has already been institutionalized across the planet (...). I intend to replace geo- and state politics of knowledge from its foundation in the imperial history of the West over the last five centuries, with geo-politics and state politics of people, languages, religions, political and economic concepts, subjectivities, etc., who have been racialized (...). The de-colonial option means, among other things, learning to unlearn (...) De-colonial thinking also means de-colonial doing, since the modern distinction between theory and practice does not apply when you enter the field of de-colonial projects (...) (Mignolo, 2008, p. 290, our translation).

The de-colonial option accompanies postcolonial analytics by showing how universalization, uniformization, binarism and historical linearity, that is, the bases of modern rationality, were converted into elevated forms of understanding through irrationally violent, narcissistic, and racist cover-up, demotion and exclusion of knowledge not based on the same rationale (Macedo, 2004; Mignolo & Walsh, 2018). The de-colonial option acts against established colonialities and opens our eyes to the existence and the need for the coexistence of various subjectivities (Mignolo & Walsh, 2018).

Among the analytical categories of the Modernity/Coloniality Network — transmodernity, colonial difference, frontier thinking, interculturality, *hubris* of point zero and body politic — the *coloniality of power* (Quijano, 2005) stands out as a key category (Castro-Gómez, 2021). The concept of coloniality alludes to the symbolic and cognitive scope of the permanence of colonial rule (Quijano, 2005). The mechanisms of *coloniality of power, knowledge and being*, structured by the idea of race, function by introjecting the subjectivity of the colonized, of the colonized from an alleged superiority of ontology and the episteme of the metropolis. In addition to the triad of power, knowledge and being, other developments of colonialities were proposed. Considering the experience of women of color, María Lugones (2008) highlights the *gender coloniality*. The philosopher criticized the hyperbiologicalization of the notion of gender in Quijano and demonstrated that only with the intersectionality of gender and race would it be possible to see the experience of women of color in the colonial enterprise. Finally, the exploitation of non-humans as resources is discussed through the concept of *cosmogonic coloniality or coloniality of nature* (GESCO, 2012; Walsh, 2012).

Despite being often used as synonyms, de-colonial¹ and decolonial do not mean the same thing. While the first would imply the undoing of the colonial relationship, the second arises throughout the debates of the Modernity/Coloniality Collective, following a suggestion by Catherine Walsh (Walsh et al., 2018), by proposing a sense of continuity of postures, actions of resistance, transgression, and intervention for native and alternative conquests. Decolonial is most widely used to designate the agency of those who intend to confront colonialities.

We believe it is important for the above discussion to make some considerations regarding Boaventura de Sousa Santos and the Modernity/Coloniality Collective. The author is mentioned as one of its intellectual members (Ballestrin, 2013), being well known and recognized in Brazil, including participation in national conferences. Perhaps, one of his most outstanding works is *Epistemologias do Sul*, organized together with Maria Paula Meneses (de Sousa Santos & Meneses, 2009). However, Oliveira and von Linsingen (2021) emphasize that, despite Boaventura de Sousa Santos' constant dialogue with the Latin American Collective, the debate on the epistemological diversity of the world named Epistemologies of the South would represent yet another counter-hegemonic theoretical reference, of categories own, to debate the consequences of modern colonization for the epistemicide of knowledge from the South and to make proposals for the supplantation of colonialism.

In the aforementioned book, intellectuals from diverse backgrounds discuss how the pretense of neutrality, superiority and universality of scientific knowledge abysmally separated North and Global South. The concept of Epistemologies of the South is

¹ In portuguese we have the words *descolonial* and *decolonial*, that are frequently translated to English using the same word *decolonial*. As the purpose of this text is to explain this set of concepts we adopted the manner that is written in the abstract of a translation from a Mignolo (2008)'s article: de-colonial when in Portuguese/Spanish we would use *descolonial*. When we use *decolonial* we refer to the term as Catherine Walsh proposed (cf. Walsh, de Oliveira & Candau, 2018).

markedly useful for denouncing the marginalization of knowledge from the Global South and for investigating the conditions for establishing an ecology of knowledge, a horizontal dialogue between hegemonic and non-hegemonic knowledge.

With regard to education, two very important discussions that emerge from the Modernity/Coloniality Collective are decolonial pedagogy and critical interculturality. The dominant pedagogies in the West have an instrumental character, focus on teaching-learning processes structured in formal teaching environments, with monocultural, Eurocentric curricula, supported by racist, sexist and classist ideologies, which consider non-whites, women (Petri & Fonseca, 2019), peasants and non-humans (M. M. Silva et al., 2020) as dispossessed of intellectual capacity when compared to “normative humans”, erasing and inferiorizing people of color.

Critical interculturality, unlike other intercultural logics and multiculturalism (Walsh, 2012), engages with decolonial pedagogical interventions on coloniality, seeking to transform existing power structures through a political, social, epistemic, and ethical project. Thus, decolonial pedagogy and critical interculturality are essential to call “into question the sociopolitical reality of neocolonialism and the epistemological domination that indigenous peoples are subjected to” (M. M. Silva et al., 2020, p. 43, our translation) and other minorized identities.

Synthesis

Modern European estates, in addition to establishing social and economic disadvantages that became prominent in colonized countries, did also disregard the knowledge produced in the Global South. Such actions reverberate in several Latin American institutions, such as schools. As a reflection of the past, local school curricula and practices remain subjugated to the supposed superiority of Euro-American cultural elements. In this sense, the contribution generated by critical perspectives of the colonial enterprise for science education is located in the possibility of recognizing and intervening in the geopolitics of knowledge production.

Several counter-hegemonic perspectives emerged against colonialism since its inception. First initiatives were rebellions against formal exploitation. These anti-colonial demonstrations moved towards the desire to break free from the administrative submission to metropolises. These anti-colonial and anti-hegemonic demonstrations culminated in the later understanding that the colonizers occupied more than the territories, being able to inject a false superiority into the minds and hearts of colonized peoples. Despite drawing on European intellectuals, post-colonial theories that emerged in the 1950s played an important role in highlighting the need to consider discursive and symbolic domination in order to take an effective stance against the colonial bonds that still linger beyond the administrative liberation of colonies.

Although we dedicated more words to the theoretical production of the Modernity/Coloniality Collective, we point out that its production cannot be seen as that of a cohesive and unanimous block (Ballestrin, 2013; Castro-Gómez, 2021). In this

section, we take the opportunity to bring two manifestations that show the limits of the Modernity/Coloniality Collective: one comes from Silvia Rivera Cusicanqui, a Bolivian intellectual linked to the Aymara people and indigenous anti-colonial movements, and the other from the Brazilian sociologist Paulo Henrique Martins.

Cusicanqui contrasts with some decolonial authors by questioning their theoretical and institutional affiliations linked to Northern countries. In addition, she is quite resistant to what she considers “epistemic extractivism”, made by people who even claim to speak for the subalternized (Grosfoguel, 2016b). Among his claims would be the decentering of sociology and historiography analyzes for the inclusion of the indigenous epistemological paradigm, in which “animate”, and “inanimate” beings are as much subjects as humans (Pimentel, 2021).

It opposes the assumption that the coexistence of indigenous peoples with the surrounding society could produce a certain homogeneity, present in the postcolonial notion of hybridity, with the Aymara notion of Ch'ixi — “something that is and is not at the same time” (Rivera Cusicanqui, 2010, p. 69 our translation). For her, the coexistence of indigenous peoples with the colonizers would not be able to transform them into others, but it would allow them to transit between worlds. Listing two other criticisms made by Cusicanqui, one of them refers to the intertwining of the university, knowledge, and colonization through the epistemic destitution of indigenous languages, excluding those who do not master the grammar and norms of European languages (Ramos Júnior, 2020).

The Brazilian Paulo Henrique Martins (P. H. Martins, 2019) also shows the limits that the Modernity/Coloniality Collective has in terms of its ability to break with European knowledge structures; by building internal and external academic alliances; and with regard to dialogue as non-hegemonic knowledge systems. He indicates a new turn that has been materializing in Latin America and the Caribbean (after the linguistic turn of the 1980s and the decolonial turn of the 1990s): the Critical Theory of Coloniality. It stems from transnational exchanges between South-South and South-North dialectically with elements of European critique, decolonial and French anti-utilitarianism.

Finally, we highlight one more recent original proposition to think about the theme of colonization and its impacts: the counter-colonialism of Antônio Bispo dos Santos, also known as Nego Bispo. He contests the idea of harmonious coexistence between the individuals that make up Brazilian society — *quilombolas* (Pt.), indigenous people, peasants, citizens of popular classes and dominant classes — emphasizing the pain caused by colonization and the permanent struggle of the objectified afropindoramic people for their ways of existing. Bispo reflects on the effects and consequences of differences in the religiosity of colonizers from monotheistic worldviews and the polytheistic view of counter-colonizers in colonization processes. The author also draws parallels between colonial extractivism and capitalist developmental threats against original and traditional populations and points out ways of greater integration between humans and nature for a more harmonious coexistence between peoples (A. B. Santos, 2015).

By listing some counter-hegemonic perspectives to colonization produced mainly in Latin America, we do not intend to reach them in full, nor to establish comparisons between them. Regarding the complexity and magnitude of such a task, we agree with Martins (2019). Besides, there are excellent texts in science education that deal with postcolonial and decolonial theories (Carter, 2012; Cassab & Tavares, 2009; Macedo, 2004; Monteiro et al., 2019). In this manuscript, we approached the heterogeneity of the field (da Silveira et al., 2021) through the exposition of propositions belonging to *anti-*, *counter-*, *de-*, *des-* and *post-* colonialisms and southern epistemologies as they were appropriated by the field of Science Education. These theories share a commitment against the perverse exploitation of humans and non-humans established worldwide from the 16th century onwards. In addition, such elaborations are committed to overcoming the inequalities and oppression suffered by the peoples of the Global South, proving to be very relevant to Science Education.

Why Should Science Education Also be Resistant to Colonial Impacts?

The utilitarian and functional character of the scientific knowledge produced and perfected with colonization was appropriately suited for the purpose of optimizing the exploitation of resources in the Americas. Thus, from an ethnocentric epistemic perspective, European scientific knowledge has established itself since colonization as a totalitarian model of rationality, disregarding the legacy of indigenous, black, yellow, and olive people as common sense (Quintero et al., 2019; Sousa Santos, 2008).

Knowledge and political power fed back to the hegemony of Western Europe (Harari, 2017) and were the germs of the coloniality of knowledge (the epistemic claw of the coloniality of power), which traces the order of global geopolitics (Ballestrin, 2013). The knowledge of the 'others' continued to be conceptualized as inferior or local, reproducing the colonizer-colonized epistemological domination. The superiority of North-Eurocentric knowledge in the colonial relationship remained structural, as can be seen from the analysis of institutional practices in Latin America throughout history.

Let us return, to illustrate, the establishment of schooling in our continent. School education in Latin America began in the 16th century, with the European religious missions, which spread Christianity, its languages, and values of its culture through Eurocentric pedagogical processes, with the purpose of replacing the "wild" by the "modern" (Saviani, 2013). The modern Europeans, with the colonial enterprise, dragged the cultural good news to the inhospitable New World in the same pocket as rosaries, books, and whips (Grosfoguel, 2016a).

The independence and emergence of national states and their derived written documents, public institutions such as hospitals, prisons and schools in Latin America became responsible for consummating the native elites' fetish for the modern Eurocentric project. The national projects of development and progress were linked to the capitalist structure of the exploitation. Instead of rules that established "how to be a good peasant, good Indian, good black or good *gaúcho*, since all these human types were seen as belonging to the scope of barbarism" (Castro-Gómez, 2005, p. 172, our translation),

manuals were drawn up to discipline the savages with foreign customs, values, and knowledge, as well as to make them consumer labor useful to the homeland. As an example, science education in Brazil at the beginning of the 20th century focused either on classical academic content or hygiene and health practices (Cassab & Tavares, 2009).

In the 21st century, science education did not change so much: Brazilian science curricula still stigmatizes native populations as a hindrance to development (Leal & da Silva, 2020). The false narrative of an epic Portuguese discovery (instead of the actual invasion and exploitation of indigenous territories) remains untouched despite cave paintings on the walls and other evidence of human presence in the continent for more than ten thousand years. The European statue of a “blind” justice guards the entrance of most Brazilian court houses even if Xangô² would have his eyes opened to the racism often enacted in these courts (Figueiredo et al., 2019). Some citizens from the Global South often count on international organizations to finance socio-educational projects but forget that not only economic but symbolic loans do not come without interest. The ‘interest’ in cultural and educational exchanges with the imperialist power is charged whenever our bodies and minds are required to gravitate around their narcissistic definition of development (Castro-Gómez, 2005), whenever we are required to admit their standards of knowledge as hegemonic (Meneses, 2019).

By uncritically embracing initiatives that succeeded in Europe or the US, we should remember that, in our peripheral context, non-hegemonic knowledge has been a source of resistance and existence against the modern and imperial/capitalist/patriarchal/racist/sexist order. In large, this colonial order undermines non-hegemonic knowledge as it marginalizes the people from the Global South through an international division of intellectual labor (de Sousa Santos & Meneses, 2009).

As the Brazilian rap song Negro Drama says: *Periferias, favelas, cortiços... Você deve tá pensando: o que eu tenho a ver com isso?*” (Rock & Brown, 2002). What would the teaching of natural sciences have to do with society, culture, and gender if natural phenomena are defined as universal, neutral, objective, and disembodied (Bernardino-Costa, 2016)?

(...) science education, like other forms of education, has the same ethical responsibility to contribute to subject formation. Adopting decolonising curriculum and pedagogies that critically examine the geopolitics of knowledge and power structures, at the same time as they consider the material conditions of coloniality, and intellectual histories and experiences of colonised people can be part of that subject development (...) means going beyond the usual critical perspective housing injustices and oppression of all types, and interrogating the Eurocentric coordinates that remain in play in many of the world’s formations. It means exposing to the students, the ever present (re)inscription of colonial power relations, even as they maybe unintended. And it means science being taught/learned in different contexts, cultures, peoples and experiences. (Carter, 2017, p. 1065)

² Worshiped both in Umbanda and Candomblé Ketu (two of the main Afrodiasporic religions found in Brazil), Xangô is often described as the deity of justice.

To contribute to the discussion, we will de-essentialize the Western concept called “nature”, since local experiences about it are not consensually shared. In the modern conception, which we generally share, nature figures as a set of non-human ecological systems, seen as a resource to be explored and manufactured (E. S. S. Carvalho & Ramos Júnior, 2017). Unlike the moderns, who reified and packaged everything that was not (self)classified as human under the nickname of nature, “(...) there are peoples who do not conceive nature as an external and manageable domain, available to humans” (Süssekind, 2018, p. 244). Studying nature as it is often portrayed in schools and universities (i.e., as independent from culture) is a shortcut to the hegemonic epistemology of natural science as a neutral knowledge (Bernardino-Costa, 2016). In addition, such a fragmented view (separating culture from nature) undermines the theories on sustainability that have become urgent since the Capitalocene (Datta et al., 2014). For further discussions on science-culture education, we recommend reading contributions from Ogawa (1995), Aikenhead (2001), El-Hani and Mortimer (2007).

As much as we have advanced considerably in a few decades, the all-encompassing arrogance of modern Western reason — *hubris* of point zero (Ballestrin, 2013) — and its principles of rationality are still found in science education. Even if we might feel eventually disoriented, it is not possible to remain numb. In a country which historically constructed social asymmetries have been deepened, it is particularly unfair to operate under the *aegis* of a monocultural, Eurocentric curriculum, supported by a racist, sexist and classist ideology. Fortunately, as we will be able to show in the Results and Discussion section, Brazilian researchers in science education are increasingly engaged with the various oppressive layers of injustice in the Global South.

Research Production Conditions

To observe (if and) how the field of Science Education has historically appropriated references of resistance to colonization, in July 2021, we carried out a search without defining initial and final time frames in electronic indexers using the expressions ‘*science education*’, and ‘*science teaching*’. In these terms, considering the polyphony of counter hegemonic perspectives against colonization, in order to reach the greatest possible number of theoretical stances, we employed the radical *colon* associated with the left and right margins of the asterisk (*) truncator. We adopted such a strategy in order to reach the widest spectrum of words connected to the theoretical perspectives of resistance to colonization. This way, we managed to include any prefixes (*anti-*, *against-*, *de-*, *des-*, *post-*, *counter-*...) and suffixes (*-y*, *-ial*, *-ism*, *-ization*, *-iality*, *-ialism*...). Then, after some experimentation with different search engines, we chose the DOAJ and SciELO Brasil databases. Despite our efforts, we recognize here that, by adopting these (or other) criteria, we may not capture important productions related to the struggles of science education and science teaching for greater social justice. In fact, not all productions relevant to thinking about social inequalities in science education are explicitly articulated as a critique of coloniality and published in journals indexed in the chosen databases.

For the first screening, titles, keywords and abstracts of the articles were read and, in addition, when necessary, a floating reading was performed in the full text. This step generated an initial set of 38 texts. After fully reading the manuscripts, we eliminated those not associated with the field of science education or science teaching, as well as those that used expressions associated with colonization, but whose argument was disconnected from a counter-hegemonic debate. Thus, we reached 25 texts.

After we have established the *corpus*, we extracted the following information from it: text titles, authorship, year of publication and federative unit of institutional affiliation of the authors, which were useful for achieving the framework expressed in Figure 1, the graph illustrated in Figure 2 and the map shown in Figure 3. Additionally, based on Bardin (2016), after carefully rereading the texts, we sought to organize them into categories associated with predominant counter-hegemonic theoretical frameworks, to the themes discussed and the disciplines addressed in order to make inferences about the scenario outlined by the productions that promoted intersections between the field and the target critical contributions.

Results and Discussion

At the beginning, cognitivist theories played a major role in research in Science Education. However, when we observe the current academic production in the field, we notice the increasing concern with students' socioeconomic and cultural context. Figure 1 contains the characterization of our *corpus* sorted by papers' production dates. From this chronology, Elizabeth Macedo has been the first Brazilian researcher to publish an analysis of resistance to colonization in Science Education. The author masterfully opens our list with the article *The image of science*, published in the journal *Educação & Sociedade*, in 2004. Only five years later did the theme continue. In 2009, the papers *Science, Culture and Citizenship: Cross-Cultural Science Education*, by Glenn Aikenhead and Kênio Lima and *(Re)thinking school and science teaching from the contributions of postmodern thinking: challenges and dilemmas*, by Mariana Cassab and Danielle Tavares, were published respectively in the Brazilian Journal of Research in Science Education and *Espaço do Currículo*.

Figure 1

Frame containing Titles of the text, authorship, year of publication, linked theory(s), researched questions and addressed discipline(s)

Article	Linked theory(s) or author(s)	Questions	Discipline(s) covered
A imagem da ciência: folheando um livro didático (Macedo, 2004)	Postcolonial	Curriculum	Natural Sciences
Science, Culture and Citizenship: Cross-Cultural Science Education (Aikenhead & Lima, 2009)	Postcolonial	Curriculum	Natural Sciences

Figure 1

Frame containing Titles of the text, authorship, year of publication, linked theory(s), researched questions and addressed discipline(s) (continuation)

Article	Linked theory(s) or author(s)	Questions	Discipline(s) covered
(Re)pensando a escola e o ensino de ciências a partir das contribuições do pensamento pós-moderno: desafios e dilemas (Cassab & Tavares, 2009)	Postcolonial, Modernity/ Coloniality Collective, Epistemologies of the South	Crisis of the Modern Paradigm	Natural Sciences
Método científico e controvérsias nas geociências (J. R. S. Martins & Carneiro, 2014)	Postcolonial, Epistemologies of the South	Curriculum	Geosciences
Refletindo sobre a tensão entre pesquisa e prática: o caso do ensino de ciências (T. V. Pereira, 2015)	Postcolonial	Research in science teaching	Natural Sciences
Ferro, Ferreiros e Forja: O Ensino de Química pela Le Nº 10.639/03 (Benite et al., 2017)	Postcolonial, Modernity/ Coloniality Collective	Ethnic-racial relations	Chemistry
A Decolonial Moment in Science Education: Using a Socioscientific Issue to Explore the Coloniality of Power (Carter, 2017)	Modernity/ Coloniality Collective	Initial formation	Natural Sciences
O ensino da física na educação do campo: descolonizadora, instrumentalizadora e participativa (R. G. Barbosa, 2018)	Postcolonial	Field Education	Physical
Reflexões sobre os efeitos da transnacionalização de currículos e da colonialidade do saber/poder em cooperações internacionais: foco na educação em ciências (Cassiani, 2018)	Modernity/ Coloniality Collective, Epistemologies of the South	Curriculum	Natural Sciences
Caminhos descoloniais possíveis no ensino de ciências das séries iniciais: um diálogo com a obra “Meu crespo é de rainha” (I. V. de Carvalho et al., 2019)	Sílvia Rivera Cusicanqui, Postcolonial	Curriculum	Natural Sciences
A lei 10.639/03 no ensino de ciências: uma proposta decolonial para o currículo de Química (I. V. de Carvalho et al., 2019)	Modernity/ Coloniality Collective, Epistemologies of the South	Ethnic-racial relations	Chemistry
Leitura, Linguagem e saber: reflexões a partir da análise discursiva de dois textos no contexto da educação em ciências (Machado & Giraldi, 2019)	Modernity/ Coloniality Collective, Epistemologies of the South	Initial formation	Biology

Figure 1

Frame containing Titles of the text, authorship, year of publication, linked theory(s), researched questions and addressed discipline(s) (continuation)

Article	Linked theory(s) or author(s)	Questions	Discipline(s) covered
Problematizando el discurso biológico sobre el cuerpo y el género, e su influencia em las prácticas de enseñanza de la biología (Marin, 2019)	Modernity/ Coloniality Collective	Body and gender	Biology
Educação em Ciências na Escola democrática e as Relações Étnico-Raciais (B. C. S. Pinheiro, 2019)	Anti-colonial, Modernity/ Coloniality Collective	Ethnic-racial relations	Natural Sciences
A Educação em Direitos Humanos no Ensino de Ciências em interface com a teoria do Giro Decolonial: uma análise (R. D. V. L. de Oliveira & Salgado, 2020)	Modernity/ Coloniality Collective	Human Rights Education	Natural Sciences
Afrocentrando discursos por outra natureza da ciência e da tecnologia para ensinar ciências (De-Carvalho, 2020)	Modernity/ Coloniality, Postcolonial Collective	STS Relations	Natural Sciences
Ensino e Amazônia: a análise da música “Belém-Pará-Brasil” no desvelamento da colonialidade como crítica socioambiental (P. C. Pinheiro, 2019)	Modernity/ Coloniality Collective	Environmental education	Natural Sciences
Educação Científica, (Pós)Verdade e (Cosmo)Políticas das Ciências (Ranniery et al., 2020)	Postcolonial	Post-Truth	Natural Sciences
Pós-verdade para quem? Fatos produzidos por uma ciência racista (Rosa et al., 2020)	Anticolonial, Modernity/ Coloniality Collective, Post-criticism	Post-Truth	Natural Sciences
O ensino remoto emergencial de Ciências e Biologia em tempos de pandemia: com a palavra as professoras da regional 4 da SBENBIO (MG/GO/TO/DF) (A. T. Barbosa et al., 2020)	Modernity/ Coloniality Collective	Continuing education	Biology
Biologia celular, educação antirracista e currículo decolonial: experiências didáticas inovadoras na formação inicial no curso de Ciências Biológicas (J. A. N. Silva, 2020)	Postcolonial, Epistemologies of the South	Initial formation	Biology
Interculturalidade crítica na formação de professoras(es) de ciências da natureza: um legado da cooperação brasileira em Timor-Leste (P. B. Pereira, 2021)	Modernity/ Coloniality Collective	Continuing education	Natural Sciences

Figure 1

Frame containing Titles of the text, authorship, year of publication, linked theory(s), researched questions and addressed discipline(s) (continuation)

Article	Linked theory(s) or author(s)	Questions	Discipline(s) covered
Alternativas epistêmicas emergentes na ciência e seu ensino a partir do sul global (M. C. D. Oliveira & Von Linsingen, 2021)	Epistemologies of the South, Modernity/ Coloniality Collective	Nature of Science	Natural Sciences
O sul enquanto horizonte epistemológico (Caurio et al., 2021)	Epistemologies of the South, Modernity/ Coloniality Collective	Research in science teaching	Natural Sciences
Material para o Ensino de Ciências para Crianças com Limitações Comunicativas: Proposta de Análise Semiológica de Cartões do Picture Exchange Communication System (Gomes et al., 2021) em especial neste estudo, as pessoas com Transtorno do Espectro Autista (TEA)	Postcolonial	Disabled people	Biology

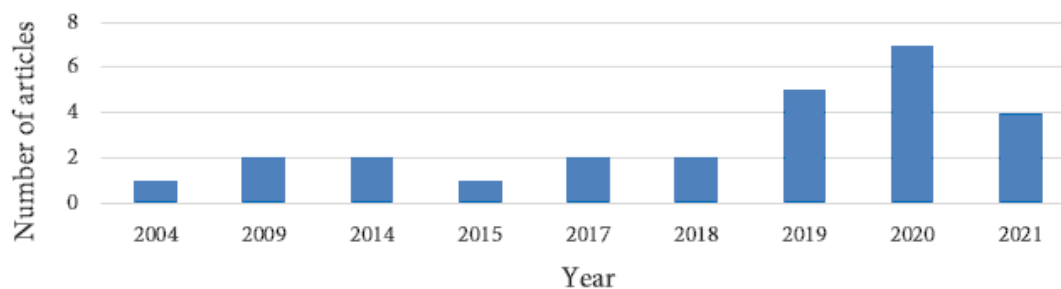
Source: Prepared by the authors.

Between 2004 and 2018, the rhythm of productions in Brazil did not change much, oscillating between one and two publications per year. This situation is a little different from that perceived by the analysis of debates in foreign journals, in which discussions involving culturally sensitive science teaching are older and more radical than in our country (P. C. Pinheiro, 2019). There are some facts that may be helpful in understanding our context. One of them can be linked to the false notion created in the Brazilian and world imagination of an alleged tranquility in relation to interethnic coexistence in Brazil, expressed by the myth of racial democracy (Carneiro, 2011). The other is related to the fact that, until recently, some canonical works on postcolonialism in Latin America were scarcely available (Castro-Gómez, 2021).

Regarding the relation between research in Education and the Modernity/ Coloniality Collective, Dias and Abreu (2020) show suggestive time frames that help understanding the incorporation of the decolonial perspective in our field. The first deals with the admission of theorists who were involved with pedagogy from a decolonial perspective, Zulma Palermo and Catherine Walsh, who joined the program in 1999 and 2001 respectively; the second is information about the date of the first productions *in the strict sense* that had decolonial pedagogy as theoretical support.

Figure 2

Publications carried out between 2004 and 2021 in Teaching/Education in Sciences that used perspectives of resistance to colonization available in the Directory of Open Access Journals (DOAJ) and SciELO Brasil in July 2021.



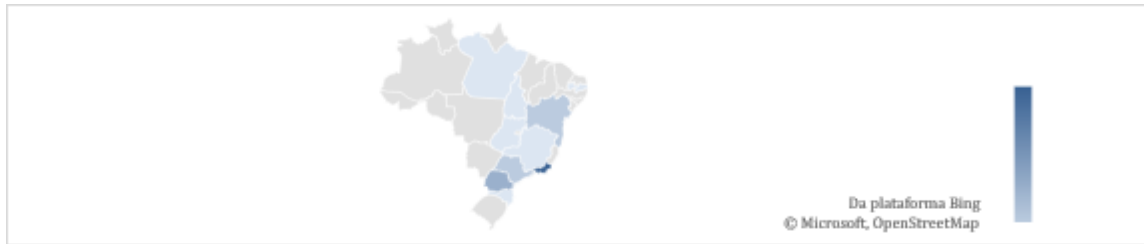
Source: Prepared by the authors.

Regarding the concepts elaborated by the Modernity/Coloniality Collective, we assume that the initially timid adhesions to this theoretical perspective of resistance to colonization in Brazil may be linked to the fact that this is a recently elaborated theoretical body, since the area of science teaching has incorporated references from different sociological, anthropological, and philosophical perspectives. Martello et al (2021) reported an increase in the number of dissertations and theses between 2016 and 2019 incorporating the decolonial framework. In turn, the view made by Castro and Monteiro (2019) shows that the works published at the National Meeting of Research in Science Education (ENPEC) on the subject had the first approximation in 2011 and, in 2017, had a production based on in postcoloniality and another in southern epistemologies. About our search for scholarly texts in SciElo and DOAJ, we realized that the set of theories of resistance to colonization began to gain greater adherence from 2019 onwards (Figure 2).

Adding our impressions to the reports by Martello et al. (2021) and Castro and Monteiro (2019), we question whether the growing Brazilian academic production, observed from the year 2019, would suggest a decolonial turn in science education. Numbers are quite encouraging, but they need to be observed with a magnifying glass. Except for 3 articles whose institutions of origin of the first author are located in other countries, the Brazilian states that concentrated most of the production are in descending order: Rio de Janeiro (6), Santa Catarina (5), Paraná (3), São Paulo (2) and Bahia (2) belonging to the southeast, south, and northeast regions (Figure 3). A close result can be seen in Martello et al (2021) who highlight the number of dissertations and theses defended in Santa Catarina and Bahia. The authors (2021) relate the result with the study groups on the decolonial debate in science education existing in the cited federative units.

Figure 3

Distribution of corpus units by federative unit in Brazil



Source: Prepared by the authors in Microsoft Excel.

Concerning our research object, academic texts published in indexed national journals, we observed that, among the five states that stood out, four belong to the southeast and south regions. What could we infer from this finding? Would such distributions be reflections of an internal coloniality?

First, we inform you that by associating scientific production with the superstructures of our society, instead of opting for the concept of internal colonialism (cf. González Casanova, 2007), we opted for the expression internal coloniality that carries with it the epistemic dimension of regional hierarchization. As a reflection of this phenomenon, in our area, we still suffer from an unequal distribution in the national territory of graduate programs in science teaching/education, as it occurs in other areas (cf. A. C. de B. Gomes, 2019); we also noticed the disparity in production volumes in periodicals indexed by region and in the prestige received. This has direct implications for the national distribution of incentives for the development of research, grants, visibility, and dissemination.

The impacts of social, political, and educational inequalities - intentionally or not - maintained between regions are beyond the number of articles published in periodicals of national and international relevance. Although the Northeast, North and Midwest regions have qualitatively less academic production, this does not mean that in these localities efforts to resist in this way to know and contribute to maintaining different forms of life and cultures are not being carried out, but that unfortunately they have been little praised (Costa et al., 2022; Oda, 2019).

The noted asymmetries are not recent and perpetuate colonial relations by generating benefits for historically privileged groups instead of others. The intention, through this analysis, is to underline the structural causes for the perceived distortions in the symbolic domains. With such an argument, however, we do not intend to indicate that such discrepancies are the result of the deliberate choice of well-positioned researchers in the area, who work in regions more aligned with the ideals of modernity, but that ignoring their permanence may turn out to be.

With regard to theoretical influences, most of the works appropriate the theoretical perspectives of resistance to colonization, mixing different references that, as they do not intend to be totalizing the phenomenon of colonization and its worldwide consequences, can flow in the arguments in a complementary way. Based on our analysis, propositions of a post-colonial nature became predominant, as we included in this grouping canon authors and other personalities, critics of the colonial discourse, such as bell hooks, Grada Kilomba, Bruno Latour, Isabel Stengers, Kabele Munanga, Paul Gilroy, Cheik Diop. Many of the authors also drew on Freire to build their arguments. In the work *Pedagogy of the Oppressed* (Freire, 2014), Paulo Freire dialogues with Fanon and Memmi when describing how the oppressed was seduced by the logic of the oppressor, self-devaluating himself. We prefer not to classify the articles in terms of the use of Paulo Freire's work, as we believe that it speaks to elements present in anticolonial, postcolonial and decolonial discourses.

Intellectuals from the Modernity/Coloniality Collective were frequently summoned in the analyzed manuscripts based on the concepts of coloniality of power, coloniality of knowledge, coloniality of being, coloniality of nature, critical interculturality and decolonial pedagogies. We highlight the references made to Aníbal Quijano, Walter Dignolo, Catherine Walsh, Enrique Dussel and Santiago Castro-Gómez. The mentions of Boaventura de Souza Santos and Maria Paula Meneses, organizers of the *Epistemologies of the South* compendium, were very present. Regarding Silvia Rivera Cusicanqui, Paulo Henrique Martins and Nego Bispo, only the first has been quoted. We assume, due to their theoretical potential, that in the future the works of Brazilians will gain prominence in the area of Science Education.

The discussions generally deal with the natural sciences *en bloc*. But separately, Biology was the most discussed discipline, in twenty percent of the articles, while Chemistry was the focus in two of them and Physics and Geosciences, one for each. In turn, the diversity of the themes explored demonstrates the crossing capacity that the perspectives of resistance to colonization present for Science Education. Considering that such perspectives question the naturalization of the Eurocentric power established with colonization, it becomes quite understandable that the Curriculum field, as it highlights issues of power in school activity, has been the most explored. Other subjects such as Ethnic-Racial Relations, Initial Teacher Training, Research in Science Teaching, Environmental Education, Post-truth, Continuing Teacher Training, School and the Crisis of the Modern Paradigm, Rural Education, Biological Discourse on Body and Gender, Education in Rights Humans, STS Relations, Nature of Science and Teaching for People with Disabilities, common in research in the area (Maldaner et al., 2011) were explored by the authors.

Finally, we list some events that we consider influential for establishing the year 2019 as a milestone in overcoming the plateau that was outlined in relation to academic production in science education associated with theoretical perspectives of resistance to colonization. Without claiming to be comprehensive, we list some events that reinforce our proposition:

1. The change in the sociocultural profile of universities in Brazil through the implementation of affirmative action policies. The process started in the State of Rio de Janeiro in the 2000s inspired other states in that decade and culminated in Federal Law 12,711 of 2012, which provides for admission to federal universities and federal institutions of secondary technical education. The admission and permanence of black, *quilombolas*, indigenous and LGBTI people in graduations, post-graduations, as well as servants and servants has powerfully turned the ways of thinking, acting, and producing in the academic environment;
2. The participation of Catherine Walsh, a member of the M/C Collective linked to discussions on decolonial pedagogy, in a seminar with Professor Vera Candau, in Rio de Janeiro, in 2007;
3. The publication of the first thesis on the education of ethnic-racial relations in science education by Douglas Verrangia Corrêa da Silva (2009); as well as the already mentioned first theses in the field of Education on decolonial pedagogies in 2010 and 2015;
4. The publication of the work *Being x Knowing - Symbolic effects of coloniality in the relationships between subjects and scientific knowledge* the VIII ENPEC in 2011, by Patricia Barbosa Pereira and Suzani Cassiani;
5. The holding of the XI ENPEC in Florianópolis in which the Working Group was developed *Research in Science Education: Theoretical Contributions of Studies on Colonialities and subordinates*; the first-round table (in an ENPEC) on Decoloniality with the participation of Adela Molina, Celso Sanchez, Katemari Rosa and Maria Paula Meneses. The event also had the presence of the Australian professor Lyn Carter;
6. The occurrence of the XII ENPEC in Natal, with the launch of the seminal book *Decolonialidades na Educação em Ciências* and three round tables: Science education at the Democratic School and ethnic-racial relations, Science education at the Democratic School: gender and sexuality and Research in Science Education: difference, social justice, and democracy. In addition, for the first time, indigenous and trans speakers gave speeches;
7. And, additionally, the publication of the books: *Decolonizing knowledge Law 10639/2003 in science teaching* (B. C. S. Pinheiro & Rosa, 2018); *School decolonization trajectories: Facing racism in science and technology teaching* (B. C. S. Pinheiro & Rosa, 2018); *@Descolonizando_Saberes Black women in science* (B.C.S. Pinheiro, 2020) and *To resist, (re)exist and (and)invent scientific and technological education* (Cassiani & von Linsingen, 2019);

8. The engagement of female and male researchers in virtual fronts such as the Liquens UFRJ research group channel on Youtube (<https://www.youtube.com/c/LiquensUERJ>), such as the website of the International Collective of Decolonial Studies in Education Scientific and Technological RIEDECT (<https://riedectdecolonial.wixsite.com/my-site>) and on social networks, such as the profile of Professor Bárbara Carine Pinheiro on Instagram @uma_intelectual_diferentona (https://www.instagram.com/uma_intelectual_diferentona/) which, at the beginning of May 2023, already reached 252,000 followers.

We hope that the efforts of research groups and researchers in the area with the dissemination and appropriation of theoretical perspectives of resistance to colonization, which began in 2004 and gained clearer contours from the year 2019, can reach more and more educators and educators in critical sciences, committed to overcoming the inequalities and oppression suffered by the peoples of the Global South. We believe that the plurality and scope of analyzes found in anti-, contra-, de-, des, post-colonial theoretical bodies provide a basis for science educators to guide the epistemopolitical attitude necessarily contrary to the perverse exploitation of humans and non-humans that established worldwide from the 16th century.

Conclusions

In science teaching, the Enlightenment imaginary still shapes the curriculum (Macedo, 2004). The permanence of Eurocentric reasoning in teaching natural sciences hinders social development. This way, theoretical perspectives of resistance to colonization (such as post-colonial and decolonial critiques) have been crucial for challenging the privileged position of modern science in the school curriculum. However, resonating with such critiques does not imply the complete abandonment of scientific ideas. Instead, decolonial reasoning in science education implies an attention to ambiguities that might be found even in well-executed and well-intentioned teaching initiatives.

Given the contemporary complexity of power relations, it is appropriate to shift from an obediently naive position towards another that is more questioning. About our best intentions as educators, we must cast doubt on naturalized paradigms. What is universal? What is development? Whom does this development serve? What knowledge is legitimate?

It is important to point out that, regarding the teaching of natural sciences in Brazil, there are political and epistemological challenges for overcoming curricular and institutional Euro centering. Deconstruction is not unanimous. There are those who reportedly maintain a more conservative stance on the subject for science education (Maia & Carneiro, 2018); in science teacher education, the teacher's imagination still seems to be affected by Enlightenment conceptions (Macedo, 2004). Perhaps, a good part of the area's contingent is still enchanted by the myth of racial equality, ignoring the consequences of colonization for school science education (Coelho & Silva, 2019).

As for our title question, if we understand a *turn* as an overwhelming change in a research field, *we not experiencing a decolonial turn in Brazilian science education yet*. The number of texts produced has increased, but this quantity is not very expressive when compared to other influential theoretical and methodological perspectives (C.S. Santos et al., 2022). Besides, a large quantity of research outputs would not be enough to achieve a decolonial turn. It takes more than that.

A decolonial turn is not a place we will eventually arrive at. Instead, it is the process itself. As long as people across the country cannot equally enjoy the symbolic goods produced by science, our struggle must continue. Despite the attentive and critical look, we are also capable of sketching optimism and, if we recall the expression *turn*, as the Latin American decolonial perspective, we observe that, even with all the recent political uncertainties and with the maintenance of past hierarchies, from insurgent individual and collective actions, generated both from prestigious and marginalized localities, we have decolonially turned.

This is, therefore, an invitation to us, science educators, after acknowledging the arrival in 2004 of a new theoretical framework for the area (which began to occupy greater space as theoretical references in indexed journals from the year 2004 onwards), to look deeply into the eyes of the scientific fields we choose to work with, and then devour them! Feeling, throughout the process, each note of its seasoning, realizing which ones can remain, as they are relevant to our ideal of democracy and anti-racism, and which ones would be transformable to meet our demands.

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Compliance with Ethical Standards

The authors declare this study was conducted following ethical principles.
