

SCIENCE AND DIVERSITY: INDIGENOUS ASTRONOMY AS A TOOL TO COMBAT RACISM IN EDUCATION

CIENCIA Y DIVERSIDAD: LA ASTRONOMÍA INDÍGENA COMO UNA HERRAMIENTA PARA
COMBATIR EL RACISMO EN LA EDUCACIÓN

CIÊNCIA E DIVERSIDADE: A ASTRONOMIA INDÍGENA COMO MEIO DE COMBATER O
RACISMO NA EDUCAÇÃO

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Abstract

This paper analyzes astronomical knowledge from the perspective of epistemological diversity, aiming to reduce the distance between science and culture and combat epistemic racism, while valuing the various forms of knowledge. Therefore, this study is a theoretical essay of critical origin, which discusses and problematizes the current model of interculturality in science teaching. Relevant references in the areas of Indigenous Astronomy, Education and Science Teaching were used as a basis for this study. The investigations enabled the diagnosis of a worsening of the problems related to the invisibility of epistemic racism, the mechanisms used to silence diversity that does not follow the Eurocentric pattern and the disappearance of Indigenous Knowledge systems. In addition, this study considers Indigenous Astronomy from different ethnic groups as a tool for combating racism in science education, as well as presenting a set of actions in science and society.

Keywords: Epistemic racism; Diversity in Science; Indigenous Astronomy; Science Teaching.

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Resumen: Este trabajo analiza el conocimiento astronómico desde la perspectiva de la diversidad epistemológica, con el fin de reducir la distancia entre la ciencia y la cultura, y combatir el racismo epistémico mediante la valoración de las diferentes formas de conocimiento. Este estudio es, por lo tanto, un ensayo teórico de origen crítico, que discute y problematiza el modelo actual de interculturalidad en la enseñanza de las ciencias. Como base para este estudio se utilizaron referencias relevantes en las áreas de Astronomía Indígena, Educación y Enseñanza de las Ciencias. Las investigaciones permitieron diagnosticar un agravamiento de los problemas relacionados con la invisibilización del racismo epistémico, los mecanismos utilizados para silenciar la diversidad que no sigue el patrón eurocéntrico y la desaparición de los conocimientos de los pueblos indígenas. Además, este estudio considera la Astronomía Indígena de diferentes etnias como una herramienta para combatir el racismo en la enseñanza de las ciencias, además de presentar un conjunto de acciones en la ciencia y en la sociedad.

Palabras clave: Racismo epistémico; Diversidad en la ciencia; Astronomía indígena; Enseñanza de las ciencias.

Resumo

O presente trabalho analisa o conhecimento astronômico sob a ótica da diversidade epistemológica, a fim de reduzir as distâncias entre ciência e cultura, e combater o racismo epistêmico, valorizando as diversas formas de saber. Logo, este estudo trata-se de um ensaio teórico de origem crítica, que discute e problematiza o atual modelo de interculturalidade no Ensino de Ciências. Utilizaram-se, como fundamentação para este estudo, referenciais relevantes nas áreas da Astronomia Indígena, Educação e Ensino de Ciências. As investigações possibilitaram diagnosticar um aprofundamento dos problemas relacionados à invisibilidade do racismo epistêmico, aos mecanismos para silenciar as diversidades que não seguem o padrão eurocêntrico e ao desaparecimento dos saberes dos povos indígenas. Além disso, este estudo considera a Astronomia Indígena de diferentes etnias como ferramenta de combate ao racismo na educação científica, bem como apresenta um conjunto de ações na ciência e na sociedade.

Palavras-chave: Racismo epistêmico; Diversidade na Ciência; Astronomia Indígena; Ensino de Ciências.

Introduction

Brazil is recognized for its continental dimensions and its social and biological diversity. Brazilian forests house a significant portion of the planet's flora and fauna. In addition to its natural biodiversity, its mixed population provides a rich mosaic of knowledge and cultures (Pinheiro *et al.*, 2019). Each people have its particular worldview and diverse interpretations, shaped by circumstances, customs, beliefs, knowledge, traditions, and values, which are reconfigured across different temporal and spatial contexts (Araújo *et al.*, 2017).

The sky is considered a cultural component that represents societies, their worldviews, and their connection to nature (Oliveira, 2020). Based on this definition, Cultural Astronomy is regarded as a field of knowledge that studies celestial bodies according to the sociocultural manifestations of each people or group (Rodrigues; Leite, 2020). In other words, Lima *et al.* (2013, p. 100) state that “Cultural Astronomy refers to the knowledge, practices, and theories developed by any society or culture regarding the relationships between the sky and the earth and what arises from these dynamics in cultural practices and representations of the world”.

Indigenous peoples were the first Brazilian astronomers (Afonso, 2006a), which is justified by the connection between their routines and natural phenomena, especially astronomical events that helped determine the best periods for harvesting, planting, hunting, fishing, and other essential survival activities (Afonso, 2010).

Indigenous Astronomy is explained empirically, as it associates the movements of the Sun, the Moon, and the constellations with daily life, as well as annual meteorological events. Therefore, the knowledge of indigenous peoples is essential for valuing nature and understanding the Universe (Garcia *et al.*, 2016), as “Astronomy was born and gradually developed to meet social, economic, religious, and, obviously, cultural needs” (Boczko, 1984, p. 2). Levi-Strauss (2004) discusses how different indigenous peoples of South America incorporate celestial bodies into their myths, demonstrating the relationship between astronomical observation and the mythical incorporation structured within the organization of symbolic thought.

Academic courses in Astronomy, or even the knowledge acquired in schools, convey the idea that even the sky has been colonized, due to the persistent attempt by institutions to promote a hegemonic view of the sky as if it were the only one, as well as to teach a method of spatial orientation that encourages students to look North instead of South (Campos, 2019). From this perspective, Grosfoguel (2007) argues that epistemic racism operates in the following manner:

The epistemic privilege of white people was established and normalized with the colonization of the Americas at the end of the 15th century. From renaming the world using the Christian cosmology (Europe, Africa, Asia, and later, America), characterizing all non-Christian knowledge or wisdom as the work of the devil, to

assuming, through their European provincialism, that only through the Greco-Roman tradition—spanning the Renaissance, the Enlightenment, and Western sciences—can "truth" and "universality" be achieved, inferiorizing all "other" traditions (which, in the 16th century, were labeled as "barbaric," transformed in the 19th century into "primitive," in the 20th century into "underdeveloped," and in the early 21st century into "anti-democratic"), the epistemic privilege of Eurocentric white identity politics was normalized to the point of becoming invisible as hegemonic identity politics. For this reason, ethnic studies, from their formation to the late 1960s in the United States, were always subject to attacks from the epistemic racism of Western humanities disciplines (social sciences and humanities), which argued for the inferiority, partiality, and lack of objectivity of their knowledge and knowledge production (Grosfoguel, 2007, p. 33).

Based on these accounts, it is relevant to consider that the paths to democratization in the country demand the right to citizenship for all, not just for a few (Paiva *et al.*, 2019). Therefore, it is essential to reflect on how Indigenous education (Munduruku, 2012) contributes to classrooms and other spaces of scientific dissemination in consolidating Indigenous alterities beyond the processes of subalternization imposed by the colonial system of power (Alves-Brito; Alho, 2022).

The teaching of Cultural Astronomy through various traditional knowledge, as cited by Jafelice (2015), is considered a challenge in the view of Alves-Brito *et al.* (2018) because materials on ethnic-racial relations in Exact Sciences are rarely available in Basic Education institutions, especially in the fields of Physics and Astronomy. The absence of this type of didactic material in schools has negatively impacted the appreciation of pluralism and cultural diversity as extensions of science, and this calls for improvements in the multiculturalism approach (Santos *et al.*, 2023).

This study seeks to analyze the construction of astronomical knowledge through the lens of epistemological diversity, aiming to unveil the intersections between science and culture and to combat epistemic racism, valuing the various forms of knowledge.

The Monopoly of Western Scientific Knowledge

Scientific reasoning has been established over the years as one of the main expressions of science, specifically Western Science, becoming the sole pathway for the legitimization of peoples and cultures, as well as the only means of civilization, development, and progress for humanity (Celestino, 2024).

Scientific advancement is one of the goals of Brazilian Higher Education. This objective is outlined in the National Education Guidelines and Framework Law (Brazil, 1996), which states that Higher Education aims to expand scientific reasoning, stimulate research, scientific investigation, and the dissemination of knowledge. Although the scope of Higher Education encompasses both teaching and outreach, scientific research is fundamental for the maintenance of its activities (Severino, 2013). In this context, it is no coincidence that almost 90% of the country's scientific and technological production originates from Higher Education Institutions, particularly public universities (Fonseca, 2018).

Public universities are recognized and legitimized as environments for the production of science, being considered a hegemonic form of knowledge in modernity (Severino, 2013). A significant portion of the knowledge produced and disseminated in these institutions carries characteristics of concepts historically disseminated as global, in a stereotypical and specific manner regarding science. This pattern does not consider the epistemological diversities that constitute the construction of knowledge, reducing Science to a Eurocentric standard and contributing to the subalternation of other cultures (Mattos, 2023).

As Mattos (2023) also states, the most accepted understanding of science prioritizes method and rationality, conveying impartiality and universality in investigating what is reliable and relevant for a modern society. This scientific model has been disseminated by universities in various countries, imposing an appropriate standard for scientific progress. Therefore, these institutions also play “[...] a significant role in consolidating epistemological and cultural colonization, cultivating and disseminating knowledge from an Occidental-centric perspective” (Severino; Tavares, 2020).

This appropriation of a colonizing scientific model, which contributes to the epistemicide of various peoples (Mattos, 2023), is evident. According to Santos (2007), modern thought is not impartial, as it represents an abyssal thought, characterized by an insurmountable division between two worlds, making interaction between them impossible.

The hegemonic epistemology of supremacy has a historical and social formation, whose worldview is rooted in a capitalist society composed of male, white, and Christian individuals. Thus, epistemic knowledge becomes an ideological threat to the dynamics of

power, as it was presented to colonized peoples with the ideological justification of being a culture that encompasses the entire world (Severino; Tavares, 2020). This colonization led to the disappearance of lives and cultures, as highlighted by the authors:

The violent contact between European peoples and these new peoples from Africa, the Americas, and Asia caused not only great genocides when resistance was encountered from the conquered peoples but also an equally extensive and intense process of epistemicide, which consisted of the non-recognition, disqualification, rejection, suppression, and even the destruction of typical forms of symbolic expression (Severino; Tavares, 2020, p. 105).

By adopting the hegemonic epistemology inherited from colonization, the authors conceptualize coloniality as the segregation of typical forms of symbolic expression. This segregation reinforces an arbitrary set of cultural elements, privileging and naturalizing certain knowledge and practices to the detriment of others, thus perpetuating the power relations established during the colonial period (Severino; Tavares, 2020; Mattos, 2023).

According to Bispo (2015), Black and Indigenous *racialized cosmologies* are classified as similar, fostering the encounter and development of diversities, where these ways of thinking are entirely anti-colonial. However, European-Christian *racialized cosmologies* are more notable and are endorsed by the idea of colonization. Furthermore, the works of Alves-Brito, Bootz, and Massoni (2018), Pinheiro and Rosa (2018), Alves-Brito (2021b), and Oliveira, Alves-Brito, and Massoni (2021) affirm that the fields of Astronomy and Physics face complexities when addressing racism and ethnic-racial issues. These works seek to reflect on anti-racist practices and to guide the main references that direct anti-racist education in Brazil, which must be incorporated into the planning of actions across all areas of knowledge.

Indigenous Astronomy as a social and cultural construct

Astronomy, as a social and cultural construct, is considered one of the oldest sciences, as since antiquity, humans have observed the sky to understand celestial bodies, which influence their daily activities (Bernardes, 2019). Due to the various interpretations

of the night sky, Cultural Astronomy has been classified as a way to explain the study of beliefs, traditions, and knowledge acquired by cultures throughout history, as well as mythical narratives, myths, legends, and various records that allow us to understand how different peoples interpret and explain Astronomy (Araújo; Verdeaux; Cardoso, 2017).

According to Pedrosa-Lima and Vasques de Nader (2019), Indigenous knowledge about the skies is considered one of the pathways to countering the dominant logic of Eurocentric epistemologies, as well as being fundamental in legitimizing and valuing Southern epistemologies. The authors further assert that it is not about rejecting Northern epistemologies, but about defending the exchange of culturally distinct knowledge and practices and creating new meanings among them concerning their distinctions (Walsh, 2001 *apud* Oliveira; Candau, 2010).

Indigenous Astronomy constitutes significant environmental and cultural knowledge that contributes to a worldview, as observing the sky has stimulated the creativity of peoples in favor of survival (Afonso, 2013). This field of knowledge is part of the Cultural Astronomy (CA) of Indigenous peoples and has a strong relationship with the Western sky (Jafelice, 2013). Moreover, distinct cultures may identify different constellations in identical areas of the sky, that is, in regions with the same celestial coordinates (Lima *et al.*, 2013).

One of the aspects mentioned in the work of Sampaio *et al.* (2023) concerning the survival of Indigenous peoples is the agriculture of the Truká people from Cabrobó-PE, which is guided by the phases of the Moon and the seasons of the year to predict the best times for planting, harvesting, and gathering wood. Thus, the phases of the Moon indicate which weeks and days of the month are favorable for seed germination.

For millennia, travelers have noticed that the way of reasoning, organizing, perceiving, and experiencing the world differs among various cultures (Afonso *et al.*, 2016). One example is the experience of General Couto de Magalhães (1837–1898), who wrote the book *O Selvagem*, in which he provides a rich account of the culture, mythology, and beliefs of Brazil's Indigenous peoples. The second part of the book delves into the “*Curso de Língua Tupi Viva ou Nheengatú*” (Course on the Living Tupi Language or Nheengatú), which presents important information about timekeeping and calendars among the Tupis. In one of his accounts, Magalhães offers the following narrative regarding orientation and timekeeping through stars and asterisms:

I traveled [...] with Carajás natives — and they always knew the time of night by observing the stars, with precision sufficient to perfectly regulate the marches. I am not ashamed to admit that, at that time, I knew far fewer constellations than they did. One night, they showed me that one of the patches in the sky (located near the Southern Cross constellation) resembled the head of an ostrich, and as the night advanced, the continuation of the patch appeared in the Milky Way, forming the neck and later the body of this bird. Among the Tupis, the planet Venus, known as *iaci-tatá-uaçu*, and the Pleiades constellation (*ceiuci*) frequently play a role in timekeeping during the night. In the collection of legends I publish later, there is, in one of them, a curious explanation of time (Magalhães, 1935, p. 78-79).

According to Fares *et al.* (2004), constellations represent a form of admiration that, through cultural enchantment, is fundamental for building the social foundations that motivate the development and configuration of the diversity of knowledge, which will guide the lives of social subjects shaped by a multiplicity of factors.

Based on the information presented throughout this section, we agree with Lima *et al.* (2013), who highlight that one of the misconceptions to be avoided is associating the skies of Indigenous peoples with the European system, judging these skies according to the current standards of academic Astronomy. The authors argue that this type of strategy leads to the labeling of distinct cultural knowledge as primitive and pre-scientific imposing on all peoples the development of knowledge in accordance with the European model.

Racism and the Invisibility of Indigenous Knowledge in Science Education

In Brazilian history, Indigenous peoples were the first slaves, forced to work in sugar mills, where the labor force was predominantly native, prior to the capture and deportation of Africans from their continent of origin to be enslaved in Brazil, which began around the 16th century (Marquese, 2006). However, attempts to eradicate these peoples have not ceased over the years, as even today, much research is still needed on the violence, racism, and migration faced by Indigenous peoples (Milanez *et al.*, 2019). “These situations are invisible in the country, as is the situation of Indigenous women who suffer abuse, harassment, sexual violence, or who become victims of trafficking at the hands of greedy and degraded national and international perpetrators, which is not disclosed” (Potiguara, 2018, p. 26). Thus, Milanez *et al.* (2019, p. 20163) consider this situation and many others mentioned throughout this study as “disguised racism”.

The disappearance of Indigenous sciences was justified by the colonizing mission and described as an epistemicide aimed at homogenizing the world by erasing cultural diversities (Santos; Meneses, 2020). Epistemicide is considered by scholars as a policy of epistemic death caused by the hegemonic European community (Alves; Côrtes, 2023). According to Pessanha (2019), epistemicide represents the death of thought and knowledge to protect a hegemonic group, specifically the white race.

In their work, Alves-Brito and Alho (2022) discuss epistemic racism, which prevents Black and Indigenous people from accessing education, rendering their intellectual production and knowledge inferior and negatively impacting their self-esteem. The authors also argue that it is impossible to disqualify Black and Indigenous people without diminishing their ways of being, acting, and thinking. Although Indigenous peoples are included in this work's discussion of epistemic racism, Milanez *et al.* (2019) affirm that Indigenous peoples have had little presence in debates about racism in Brazil.

According to Grosfoguel (2006, p. 1), epistemic racism is one of the most intractable forms of racism within the “capitalist/patriarchal/modern/colonial world-system”. Thus, if Eurocentrism tends to disqualify these epistemologies in order to diminish, destroy, and discredit them, it seeks to structure a world of singular thought, which refuses to consider other possible worlds beyond the white male neoliberal capitalist universalization. This demonstrates the depth of the Eurocentric epistemic monopoly within the modern/colonial world-system (Grosfoguel, 2007).

In agreement, Milanez *et al.* (2019) emphasize that various Indigenous leaders and organizations have reported the importance of investigating racism against them. This led to the creation of the project “Racism and Antiracism in Brazil: The Case of Indigenous Peoples”, which provides the following account:

If, for many academics from Brazilian institutions, violence against Indigenous populations should not or does not need to be described as racism, for the Indigenous participants of the meeting, there was no doubt that they have suffered and continue to suffer racism since the arrival of Europeans on the continent (Milanez *et al.*, 2019, p. 2170).

Additionally, the authors also discuss attempts to silence Indigenous peoples, and one characteristic of this silencing lies in the hegemonic academia, which is described in reports as a “racial confinement of the Brazilian academic world” (Carvalho, 2005/2006, p. 89). At the same time, in traditional historiography, the historical protagonism of Indigenous peoples has been concealed. In Anthropology, Indigenous cultures are frequently discussed, but little or no attention is given to racism against these peoples (Milanez *et al.*, 2019).

In Brazilian history, annihilation and integration policies decimated Indigenous peoples. Christian customs justified Eurocentric principles to civilize these peoples — who were without writing, soul, or law — so they could fit into the world of development, based on Portuguese colonial planning (Munduruku, 2012). Alves-Brito and Alho (2022) interpret “un-development” as an ethnic-racial strategy aimed at validating the ongoing project of dehumanizing Black and Indigenous bodies (racism), distancing them from power negotiations, decision-making spaces, autonomy in knowledge, and productivity. With their alterity subalternized in the sciences, Black, *quilombola*, and Indigenous peoples have become the primary targets of racist policies, excluding them from schools, universities, and spaces of cultural and scientific autonomy.

One example worth mentioning is the presence of Indigenous peoples in urban school environments, which has resulted in some accounts of the experiences they have faced. One such example is the traumatic entry of Daniel Munduruku into an urban school, as recounted in his *quasi-autobiography* titled *Memórias de índio*:

I arrived at school very motivated. I entered the building eager to learn the ways of the white people. Right away, I came across a group of classmates. They all looked a bit like me, and I felt they could become my friends. I was happy. However, as I approached them, one of them pointed at me and shouted, "Look at the Indian who just arrived at our school!!! Look at the Indian!!" I looked around everywhere, searching for this Indian! I thought it might be a bird I didn't know! When they saw that I had no idea what they were talking about, they started laughing. Only later did I realize they were talking about me. [...] It was a word that didn't fit in my small Portuguese vocabulary. Then I understood that my classmates had given me a nickname. At first, I even thought it was cool to have one, but later I began to understand that because of it, I was almost always left out of games. I realized that my nickname was a reason for mockery, and my origin was a source of ridicule. That made me very sad (Munduruku, 2016, p. 19-20).

Daniel Munduruku's experience recounts just one fragment of the violence faced by Indigenous peoples (Ribeiro, 2022)⁵. In her research on racism against Indigenous peoples in the urban environment of Santarém-PA, Kércia Priscilla Figueiredo Peixoto (2017, p. 28–29) observes that “in the Brazilian context, racism against Indigenous peoples is explicit but rarely identified as such. However, throughout my research, I noticed that Indigenous peoples began to name racism as a way to denounce the various types of offenses, prejudice, and discrimination they experienced”.

From this perspective, it is urgent that the knowledge and daily practices (ancestral sciences) of the various peoples cited in this study be discussed in schools, universities, and spaces for science dissemination — not merely in a folklorized and time-frozen context (Rosa; Da Silva, 2015). Santos *et al.* (2020) highlight the plurality of knowledge acquired through everyday life and common sense. The author also emphasizes Jovchelovitch's idea, which introduces new interpretations in the scientific field, where studies need to open new horizons to understand the asymmetries and differences that operate in all societal contexts.

Ways to Combat Racism in Science Education

In the view of Indigenous anthropologist Gersem dos Santos Luciano – Baniwa (2019), interculturality is one of the mechanisms used to preserve the dominance of colonizers. In agreement, Sampaio *et al.* (2016) affirm that, even though guaranteed by Law No. 11,645/2008, interculturality, as an important mechanism of resistance, was imposed as a form of continuation of colonial dominance. Therefore, with the growth of discussions regarding Indigenous school education, Luciano (2019) considered that interculturality has taken on new contours:

For us, the idea of interculturality can be understood from two perspectives: opening pathways for the recognition and reestablishment of colonized, subalternized, subjugated, silenced, dominated, and alienated subjects from their

⁵ We recommend reading the work “Racism Against Indigenous Peoples: An Overview of Cases in Brazilian Cities Between 2003 and 2019”, authored by Rodrigo Barbosa Ribeiro, a professor in the Department of Social Sciences at the Federal University of São Paulo (Unifesp).

societal and cosmological autonomies to a position of dialogue, interaction, coexistence, and dialectical living. The other perspective is interculturality as a promise of discursive, ideological, and still colonizing dialogue (Candau, 2000). Here, the discourse of interculturality is used to cover up, hide, mask, and at most, soften the effects of coloniality, materialized through practices of exclusion, injustice, inequality, violence, and racism against collective subjects who refuse and resist succumbing and adhering subserviently to the ways of life of a deeply predatory, anti-human, and anti-species capitalist society (Luciano, 2019, p. 60).

The author supports the assertion by Santos *et al.* (2020) regarding the necessity of a critical analysis of pedagogical practices through the lens of intercultural education. This analysis is fundamental for the construction of an anti-racist and decolonial pedagogy. In agreement, Walsh (2009) proposes in her work critical interculturality as a pedagogical tool aimed at continuously questioning racialization, subalternization, inferiority, and instruments of power. Furthermore, the author advocates for the importance of an interculturality that makes visible the different ways of living, knowing, and creating understandings and methods that not only foster dialogue between different cultures but also encourage the creation of 'other' ways of thinking, being, existing, learning, teaching, dreaming, and living that transcend borders.

According to Oliveira and Candau (2010), Catherine Walsh reflects on the following concepts: other-thinking, decolonization, and critical border thinking. Other-thinking refers to thinking derived from decolonization, a commitment against nonexistence, restricted existence, and dehumanization. Border thinking, on the other hand, promotes the visibility of other reasoning and ways of thinking that diverge from Eurocentric thought.

The distinction between nature and culture, so prevalent in Western thought, is deconstructed by authors such as Machado and Coppe (2022) and Tukano (2019). By highlighting how culture shapes our perception of nature, these authors contribute to a critique of scientific ethnocentrism. Tukano, by denouncing the imposition of a Western worldview on Indigenous peoples, revisits the roots of racism and inequality in the relationships between different cultures and their knowledge systems. Their work challenges us to rethink our concepts and build a more equitable and respectful dialogue with other forms of knowledge.

In her approach, Walsh characterizes the theme of *pedagogías decoloniales* “[...] as methodologies produced in contexts of struggle, marginalization, and resistance, which Adolfo Albán has called ‘re-existence’; pedagogies as insurgent practices that fracture modernity/coloniality and enable other ways of being” (Walsh, 2013, p. 19). In this regard, the author further states that:

Critical interculturality and de-coloniality, in this sense, are projects, processes, and struggles that intersect conceptually and pedagogically, fostering forces, initiatives, and ethical perspectives that question, transform, shake up, rearticulate, and build. This force, initiative, agency, and its practices provide the foundation for what I call the continuation of de-colonial pedagogy (Walsh, 2009, p. 25).

One example that follows Walsh’s (2009) narrative is the work of Machado (2023), who adapted Indigenous knowledge and pedagogical approaches, aiming to educate non-Indigenous individuals in an autonomous and emancipatory manner. The authors drew on the theoretical frameworks of Paulo Freire and Jacques Rancière to define the main concepts of autonomy and emancipation. The work of Machado and Coppe (2022) was also fundamental in seeking to develop strategies that contribute to the decoloniality of the curriculum. In the words of Gomes:

[...] if we want to fight racism, we need to re-educate ourselves, our families, schools, education professionals, and society as a whole. To do so, we need to study, conduct research, and gain a deeper understanding of the history of Africa and Afro-Brazilian culture, learning to take pride in the remarkable, significant, and respectable African ancestry in Brazil, understanding how it is present in the lives and history of Black, Indigenous, white, and Asian Brazilians (Gomes, 2017, p. 49).

Anti-Racist Education consists of a school curriculum with an intercultural conception, based on dialogue among diverse cultures, without subalternity and categorization of historically denied and silenced cultures. It is a horizontal dialogue based on harmony and respect for others (Freire, 1987 *apud* Uchôa *et al.*, 2021). Furthermore, Ana Canen contributes to this perspective by emphasizing that “a curriculum challenging xenophobia could benefit from a post-colonial multicultural perspective and studies on whiteness that go beyond recognizing cultural diversity, incorporating discourses that challenge exclusionary narratives” (2014, p. 91).

According to Uchôa *et al.* (2021), the school is, above all, a space of plurality. Therefore, it is the role of teachers to consider that students are individuals who coexist in harmony with diverse cultures. Thus, the author suggests that respect for diversity should be the first conduct expected from an educator committed to combating racism and building an Anti-Racist and decolonial Education.

Building on this premise, Machado and Coppe (2022), Mata (2018), and Garcia *et al.* (2022) advocate for the need to decolonize schools by proposing new practices, epistemologies, and approaches to nature. The authors highlight the importance of reviving native knowledge, as suggested by Isabelle Stengers (Stutzman, 2018 *apud* Machado; Coppe, 2022). This revival of knowledge, based on empiricism and pragmatism (Stengers, 2018), entails a set of actions and practices that challenge Eurocentric-colonial thought.

This set of actions underpins initiatives that promote decolonial pedagogies in the classroom, aiming to break away from traditional teaching methods, which are often based on a Eurocentric curriculum that disregards the knowledge and experiences of other peoples (Walsh, 2013). These actions include the deconstruction of racial stereotypes, the appreciation of Afro-Brazilian and Indigenous cultures, and the promotion of a fairer and more equitable school environment. Anti-Racist Education also demands the demystification of the myth of racial democracy, which masks the racial inequalities present in Brazilian society, denying visibility to historically marginalized groups and their contributions to national culture (Gomes, 2010). In a broader sense, Machado and Coppe (2022) assert that the proposed decolonial pedagogies are not confined to a characteristic anti-racist agenda but are rooted in knowledge and actions based on anti-hegemonic frameworks.

We base our work on Machado and Coppe's (2022) study, which contributed to the development of a set of practices aimed at combating racial prejudice in science classrooms. Table 1 presents a synthesis of ideas that go beyond merely adopting attitudes. The authors outline a synthesis of eighteen (18) items, grounded in the premise of "unlearning to learn". Based on this framework of actions, we have included a third column that incorporates elements of this reflection on Indigenous Astronomy into the realm of potential actions for science classroom teaching.

Table 1 - Table of topics to be learned and unlearned with the aim of minimizing prejudices in the classroom.

Machado and Coppe's proposition matrix (2022)		Our proposals considering Astronomy	
Unlearn	Learn	Practical activities	
1	... the idea that there is no prejudice in Brazil	... the origins and manifestations of prejudice in Brazil	Create a panel with different representations of indigenous peoples and their contributions to Brazilian Astronomy.
2	... the idea that scientific knowledge was constructed without prejudice.	... the violent processes that surround the construction of knowledge.	Use dramatization to represent a dialogue between an indigenous scientist and a European scientist, showing the importance of different perspectives on knowledge.
3	... the idea that there is social and racial uniformity in school.	... the ancestral diversity of people and the indigenous and black presence in it.	Conduct research on the history of local indigenous peoples and their knowledge of the skies and present the results orally or on posters.
4	... that there is only one form of scientific knowledge.	... the forms of science of the peoples of the globe, as well as their effectiveness.	Build an astronomical instrument used by an indigenous people, such as a sundial, and explain it to the class.
Combating the problem			
Unlearn	Learn	Practical activities	
5	... that school is a place to practice discrimination with impunity.	... What are discriminatory practices and when do we commit them?	Create a board game about cultural diversity and respect for differences, using indigenous characters and their cosmologies.
6	... that knowledge is only an objective science.	... the ways in which knowledge is constructed for purposes within societies.	Organize a discussion group about the importance of myths and legends in the construction of indigenous astronomical knowledge.
7	... the idea that indigenous knowledge is a thing of the past.	... contents, practices and current ways of knowing of indigenous peoples.	Interview an indigenous elder, discussing his knowledge about the skies and their relationship with nature.
Self-socio-criticism of today's modern world			
Learn	Unlearn	Practical activities	
8	... to see our way of being through the eyes of other people.	... to view societies and their knowledge from a single perspective.	Create a conceptual map comparing the cosmologies of different indigenous ethnic groups and Western culture.
9	... the process of degradation of current nature and its causes.	... to deny climate change and the impacts of capitalism on the environment.	Organize a campaign to raise awareness and preserve the environment, using Indigenous Astronomy as the main theme. Address how astronomical perceptions have been impacted by climate changes, such as the rainy season and the appearance of the Pleiades. Indigenous knowledge enables the perception of these changes, even without access to global data.
10	... the history of Brazil since the oppressed peoples.	... the Eurocentric history.	Create a mural with the History of Brazilian Astronomy, highlighting the contributions of indigenous peoples.

11	... a new conception of science focused on the preservation of lives.	... the eurocentric version of history of science (in the singular).	Create a card game with questions and answers about Indigenous Astronomy, encouraging reflection on the value of traditional knowledge.
Invention, valorization, reinvention and reactivation of practices and knowledge			
	Learn	Unlearn	Practical activities
12	... to do science based on the relationships between humans and non-humans.	... that there is an infallible scientific method, unique with incontestable results.	Carry out a practical experience of observing the night sky and telling indigenous myths, extracting empirical knowledge between myths and constellations, using simple instruments and recording observations in a diary.
13	... that affection is essential to make science and knowledge.	... that reason and coldness are predicates of good scientists.	Create a comic strip about the relationship between a young indigenous person and the sky, exploring the importance of feelings in the construction of knowledge. Use the emotional relationships between humans and the Sun (a character as a person).
14	... that in each school subject there is countless knowledge of historically obliterated peoples.	... that what the book or website presents is the final, unique and definitive version of that knowledge.	Organize a debate on the importance of including indigenous knowledge in school curricula.
15	... the diversity of indigenous sciences.	... that “all Indians are the same”.	Create a blog or podcast to share the astronomical knowledge of different indigenous peoples.
16	... the content and value of traditional knowledge and its bearers.	... that traditional knowledge is “superstition”, “nonsense” or anything of the sort.	Hold a science fair with projects that explore the relationship between science and spirituality in different cultures.
17	... to value practice and the body as ways of creating knowledge.	... that the mind and reason are superior to the body and action.	Create a dance or artistic performance inspired by myths and legends about the sky.
18	... describing multinatural relationships.	... that the law and the model are examples of the best kind of knowledge produced.	Build a three-dimensional model of the universe, using recycled materials and representing the different world views on cosmology.

Source: Prepared by the authors based on Machado and Coppe (2022).

The use of Table 1 as a foundation for ideas advocating an anti-racist and decolonial scientific education is justified by the fact that the authors consider this resource an instrument capable of assisting in lesson planning, encouraging teachers to reflect and rethink (Machado; Coppe, 2022). Thus, the ideas presented by the aforementioned authors are directed towards non-Indigenous classrooms, aiming to discuss Science, Technologies, the knowledge of Indigenous peoples, narratives and experiences about scientists' prejudices, and their implications for the nature of science.

In this understanding, discussing scientific racism within science can foster critical and balanced thinking about the nature of science, considering the contributions and harms caused by discourses and attitudes within this field (Verrangia; Silva, 2010; Sepúlveda, 2018; Oliveira *et al.*, 2021; Sepúlveda *et al.*, 2022). Therefore, considering the relationship between the history of scientific racism and its effects on the ethnic-racial relations established in society, it also becomes justifiable to make an articulation with the education of ethnic-racial relations.

Final considerations

This study demonstrates the persistence of epistemic racism in academia, which silences and marginalizes the knowledge of Indigenous and Black peoples. The imposition of a Eurocentric and male scientific standard devalues other forms of knowledge, contributing to the perpetuation of inequalities and the extinction of ancestral wisdom.

The analysis highlights the need for an epistemology that values the diversity of knowledge, overcoming the dichotomy between science and culture, considering that we often judge different cultures using Western culture as the benchmark, regarded as superior and the only true one.

By investigating the astronomical knowledge of Indigenous peoples, this work sought to contribute to the decolonization of knowledge and to the construction of an intercultural education that promotes respect for diversity and values traditional knowledge, recognizing that each ethnicity has its own worldview and does not separate nature from culture.

Indigenous Astronomy is an Amerindian science of great relevance at various educational levels and involves multiple areas of knowledge. It can also be referred to as Anthropological Astronomy. However, this type of knowledge is neither debated nor disseminated with the same intensity as the conventional science of universities, nor is it present in Basic Education textbooks.

This theoretical essay points to the importance of including Indigenous knowledge in school and university curricula, overcoming a Eurocentric and fragmented view of knowledge. In this context, schools should be spaces for dialogue and knowledge

exchange, where students can develop a critical perspective on the world and question social inequalities.

To advance in this direction, it is essential to invest in research that investigates the epistemological limitations of science courses and in teacher training initiatives that promote interculturality and combat racism. The fight against epistemic racism requires a profound transformation of academia and society as a whole.

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