



# Counter-hegemonic science education: understanding the effects of coloniality and proposing a decolonial pedagogy

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## Abstract

The article “Hegemonic and counter-hegemonic discourses in science education ...”, by Flavia Rezende and Fernanda Ostermann (2019), presents an interesting critical analysis of the antagonisms between the meaning of “teaching science” and of “science education.” The authors took a critical look at the construction of knowledge in the area, focusing on curricular functioning forms. Two perspectives were analyzed: traditional science teaching or knowledge itself and critical science education or knowledge to do something. The forum article provides international examples, setting focus on Brazil. In Rezende and Ostermann’s article, they use theoretical categories such as hegemonic and counter-hegemonic discourses to identify and defend the struggles situated in science education curricular proposals. My objective in this forum is to expand some ideas in line with counter-hegemonic discourses, emphasizing the understanding of the sociohistorical coloniality of knowledge to look at the science curriculum. Thus, I suggest that a deeper understanding of phenomena such as the transnationalization of curricula and the effects of coloniality can contribute to a critical and decolonialized perspective of science education.

**Keywords** Science education · Science teaching · Curriculum · Transnationalization · Coloniality effects · Decolonial pedagogy

## Resumo

O artigo “Discursos hegemônicos e contra-hegemônicos na educação científica...”, de Flavia Rezende e Fernanda Ostermann (2019), apresenta uma interessante análise crítica dos antagonismos entre o significado de “ensino de ciências” e de “educação científica”. As autoras analisaram criticamente a construção do conhecimento na área, com foco nas for-

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This forum is a response to Rezende and Ostermann (2019) Hegemonic and counter-hegemonic discourses in science education from the perspective of a post-critical curriculum theory. <https://doi.org/10.1007/s11422-019-09945-8>.

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mas de funcionamento curricular. Foram analisadas duas perspectivas: ensino de ciências tradicional ou conhecimento em si e educação científica crítica ou conhecimento para fazer algo. O artigo dialoga com exemplos internacionais, focando no Brasil. No artigo, Rezende e Ostermann utilizam categorias teóricas como discursos hegemônicos e contra-hegemônicos para identificar e defender as lutas situadas nas propostas curriculares de educação em ciências. Meu objetivo neste fórum é expandir algumas ideias que estejam alinhadas com os discursos contra-hegemônicos, enfatizando a compreensão da colonialidade do saber, como uma forma de olhar o currículo de ciências. Assim, considero que a compreensão de fenômenos como a transnacionalização de currículos e efeitos de colonialidade possam contribuir para uma educação científica crítica e decolonizada.

**Palavras-chave** Educação em Ciência · Ensino de Ciências · Currículo · Transnacionalização · Efeitos de Colonialidade · Pedagogia Decolonial

The article written by Flavia Rezende and Fernanda Ostermann, entitled “Hegemonic and counter-hegemonic discourses in science education ...” (2019), analyzed forms of curricular functioning in science education, bringing some antagonistic processes such as “science teaching” and “science education,” to understand the construction of knowledge in the area. Two perspectives are highlighted: traditional science education or knowledge with an end in itself and critical science education or knowledge that enables you to use it in everyday life. For example, Rezende and Ostermann’s identify issues of the function of science education curricular proposals:

Although the expression science education seems to be more assimilated by the literature, it hides the fact that much of science education research has actually been more dedicated to the investigation of science teaching and learning methods, especially when it comes to the teaching of Physics.

I agree with the authors’ observation of Physics teaching as well as other science content taught in Brazil and by implication in other nations. Additionally, Rezende and Ostermann criticize a science teaching model that defends the idea that “there is a universal knowledge to be transferred to the subjects and society.” This idea is central to the struggle to hegemonize the defense of knowledge itself, which relies on the “belief that scientific fields are sources of true knowledge” (Macedo, 2016, p. 61). Paulo Freire, the patron of Brazilian education, who has been attacked recently by the neoliberal establishment in Brazil, had already denounced in the 1970s that “teaching is not transferring knowledge, but creating the possibilities for its own production or construction” (Freire, 1999, p. 52), once the learner is not viewed as a mere “empty vase” where teachers deposit the knowledge. In this forum piece, my emphasis is on the urgency of overcoming a view of science education researchers that focuses more on teaching as a transmission of knowledge. Instead, I advocate that researchers view education as a broad front of formative processes such as curriculum, assessment, content, forms of teaching, and public policies, within formal education.

To expand this discussion, Ramón Grosfoguel (2016) asks two very pertinent questions, casting doubt on the origin of the idea of “universal knowledge”:

How is it possible that the canon of thought in all disciplines of social sciences and humanities in westernized universities (Grosfoguel, 2012) is based on the knowledge produced by a few men from five countries in Western Europe (Italy, France, Eng-

land, Germany, and the United States)? How was it possible for the men of these five countries to achieve such an epistemic privilege to the point, that today these knowledges are considered to be superior to that of the rest of the world? (p. 26)

According to Grosfoguel (2016), the other side of epistemic privilege is epistemic inferiority: “epistemic privilege and epistemic inferiority are two sides of the same coin. The coin is called epistemic racism/sexism in which one face is considered superior and the other inferior” (p. 27). I agree with Grosfoguel (2016). It is difficult to understand how in the twenty-first century, with so much epistemic diversity globally, we are still anchored in provincial knowledges camouflaged as universals. Why in academic communities do they often turn to this type of so-called universal knowledge? Are these universal knowledges sufficient to explain everything that occurs in such a diverse world? It is difficult to understand how white men from five countries in Europe took on a project of genocide and epistemicide during the colonization, and not make explicit that the invasion of many territories or existing nations, subordinating different continents in different ways, producing subalternization concerning colonizing countries.

In addition to epistemic injustice, many other types of violence occurred. In the book *Pedagogy of indignation*, in the chapter “The Discovery of America”, Paulo Freire (1999) reflects on the process of colonialism, the invasion of territories, as well as the violence and genocide of the natives and enslaved Africans, who “paid with the mutilation of their bodies and America’s soul and whose ills we still carry today” (p. 6). This global invasion, which involved the colonization of the Americas, Africa, and Asian continents by some European countries, promoted not only physical violence or misappropriation of natural resources but also silences any form of knowledge that does not promote the culture of the colonizer as the only possible form of knowing.

In the rest of this forum, I will expand on some ideas along the line of counter-hegemonic discourses and the decolonialization of science education, which transformatively can contribute to anti-racist education and other forms of oppression. Additionally, I will emphasize some concepts and move on to other possibilities of looking at the curriculum through a critical lens.

## **Expanding the discussion: understanding effects of coloniality and decoloniality to think about counter-hegemonic science education**

The notion of coloniality is understood as a form of a non-coercive domain, a subjective domain involved in relations of power and knowledge that we often do not perceive, which induces us to choices of being and living in the world. In general, the notion of coloniality helps us understand the “continuity of forms of domination, after the end of colonial administrations produced by the structures of the modern/colonial capitalist world-system” (Grosfoguel, 2008, p. 126). Specifically, in education, as related to the coloniality of knowledge, Eurocentrism exerts its violence, subjectively, preventing people from understanding their places in the same world in which they live (Porto-Gonçalves, 2005).

This history of colonization and coloniality’s effects produced a loss of identity, genocide, racism, theft of knowledge, and resources of colonized people. At the same time, we can also perceive how this is still currently expressed in the clothes we wear, in the architectural forms of buildings, in Eurocentric schools, in reproductive sociocultural models, customs, food, our consumerism, and even the enhancement and naturalization of white skin as favored normality. In other words, the notion of coloniality helps us to understand

one of the effects produced by the legacy of colonialism: dependence and subalternity in society, which includes education. The results of the colonality of knowledge are subjective. When analyzing the area of science education, both in research and teaching, we can observe the import of Eurocentric theories, as well as the reproduction of themes, models of investigations, teaching methods, teaching objectives, types of analyses, together producing a distancing from the local problems of Latin America.

Reading Rezende and Ostermann's text made me reflect on two cases. One the politics of curricular transnationalization, and the other is the meaning of citizenship in Brazilian official documents. In both scenarios, the effects of colonality have a sociohistorical trajectory visible today. Regarding the first case, I remembered some programs implemented in Brazil in the 1970s by the United States Agency for International Development, mainly the translations of books produced by the United States entitled the Teaching of Natural Sciences and the Biological Science Curriculum Study (BSCS). The objectives, which were heavily influenced by the space race, and the Cold War or the struggle for power between the USA and the USSR, were to encourage children and young people in countries sympathetic to the USA to become scientists. However, in Brazil, the context was completely different. We were governed by a Military Dictatorship that started in 1964, and a massive amount of social inequality framed our country. An emphasis was placed on the training of scientists. But I question why train scientists in a country where 24% of young people aged 15–19 were illiterate and in the 45–59 age group, the percentage was 43.2%. The answers are not clear, but Brazilians knew that the military needed cheap labor to exploit surplus-value, since the workers of that time needed to learn how to read to enter the labor market. Why was the same curriculum imposed on the literates and illiterates? Would basic education and research in science education still be copying foreign models?

Authors like Renato Ortiz (1994) and Roger Dale (2004) suggest that educational transnationalization attempts to transfer knowledge and ideas from one country to another. Dale (2004) disagrees with the common thought that the homogenization of the curriculum happens neutrally, due to the sharing of values of modernity and progress between countries, but rather supranational attempts to maintain capitalist structures, where countries receive molds and standards of modernity and progress necessary for their membership in the international community. These relations are based on verticalized experiences in the globalized world. For example, in studies on East-Timor education in Asia, we observed how this process silences local cultures during the Portuguese (1512–1975) or the Indonesian invasion (1975–1999). After independence, with the cultural invasions of well-intentioned international cooperation. In essence, assistentialism produced dependence and subalternity (Cassiani, 2018).

For the second case, with the end of the military regime, progress has been made, and new, more progressive laws have been enacted in education and, in particular, in the field of sciences. For example, analysis of the objectives of Brazilian National Education Bases and Guidelines Law (LDB, 1996) or National Curriculum Parameters (PCNs, 1999) indicates a strong emphasis in using the word citizenship. However, sprinkling education laws with the word citizenship do not guarantee a counter-hegemonic education. PCNs are framed by Spain's framework for Science Technology and Society (STS) education. The cost is that the framework and function of Latin American science and technology have been ignored or superseded by another form of invasion. In other words, a Eurocentric STS education, with problems imported from Europe, silence local concerns, corroborating the perspective of Science Teaching or knowledge per se. As much as STS education has played an essential role through the paths of counter-hegemonic science education, many STS proposals developed in the Brazilian context address

themes that we can call “universal”. However, there is a tendency to import problems of other countries in the Global North, to the detriment of local themes, not corresponding to students’ realities and silencing the most urgent issues in the lives of most of the populace. Consequently, this reinforces a cliché on the concept of citizenship, both in research and in basic education, even if in a subjective way (Bianchetti, Linsingenm, & Cassiani, 2019). But what could be more of an urgent issue than global warming, a topic extensively addressed in Brazilian STS education but not from a Brazilian perspective?

There are many examples: hunger, poverty, the overuse of agrochemicals, racism, sexism, and indigenous genocide. Brazil has about 210 million inhabitants and, according to a United Nations Development Report (2019), it ranks second in the world in terms of income inequality. Brazil enters the second decade of the twenty-first century with alarming data on hunger. According to United Nations Children’s Fund (UNICEF, 2018), six out of every ten children in Brazil live in poverty. According to the United Nations, in 2018, the number of hungry people worldwide was 821.6 million (1 in 9). By continents, we have Asia: 513.9 million; Africa: 256.1 million; Latin America and the Caribbean: 42.5 million. When analyzing the theme Food in the science curriculum in Brazil, Almeida (2019) points out that food education is approached mainly from a neutral science perspective, prioritizing the use of universal food pyramids or what would be a healthy diet, even though many children have almost nothing to eat in their daily lives. This phenomenon of not addressing local issues, prioritizing the so-called universal, ends up valuing a type of Eurocentric knowledge, to the detriment of local problems and knowledge, producing subordination, low self-esteem, destruction of local communities, and dependence on peoples. Another theme to be rethought in science education is racism. According to the Brazilian Institute of Geography and Statistics (2019), 56.2% of the Brazilian population is black or brown. In 2016, 25.4% of the Brazilian population lived in poverty. Among the total of people who lived in poverty, 72.9% were black or brown, which strongly implies that poverty and racism are among the results of a colonial heritage, which is also inclusive of the kidnapping and enslavement of people.

How can we just stay in a contemplative posture in science education, in the face of so much social injustice? What will we say about social injustice in 2020, in the middle of a pandemic? When do we perceive these problems that afflict the Global South? How should we and how do we face the effects of coloniality that produces low self-esteem, subordination, and dependence of the Global North? Is it possible to work on these issues within Science Education? If so, how? It is by no means a question of excluding science knowledge. I only question the need to place science education in the context of our time and spaces’ social and political problems and contradictions. I think it is crucial for the science education community to research forms of exclusion and seek alternatives for them. In this sense, we propose new underpinnings for a counter-hegemonic education in the sciences. Doing so can contribute to the development of a critical and decolonized citizenship and bring Paulo Freire to the debate on the importance of local themes, including how the science of biology contributed to racism, sexism, or homophobia.

Several authors of different nationalities have approached issues of class, gender, racism, religion, and other epistemologies (Sousa Santos & Meneses, 2013). Concerning coloniality and decoloniality in Science Education, a few works (e.g., Monteiro et al., 2019; Aikenhead & Elliot, 2010) have been developed in this last decade and have been recently renounced. The discussions they generate are essential because they become a part of the pieces that can contribute to science education advancement.

As pointed out by Walsh, Oliveira, and Candau (2018) in general in education:

there is a growing adherence on the part of several Brazilian researchers in the sense of thinking and formulating a different education perspective with and from subjects subordinated by coloniality, such as indigenous and afro-descendant peoples, quilombolas, sex-gender diversities and other markers of the opposite differences to hegemonic educational logics. (p. 6).

By bringing other ways of looking at science education, exposing Eurocentrism, the colonization of curricula, and the effect on racism, we can produce resistance. New processes, practices, and strategies of intellectual intervention emerge, such as Walsh's concept of Decolonial Pedagogy, which follows:

A work that is aimed at dismantling the constellations –psychic, social, epistemic, ontological-existential- installed by modernity and its hidden side, which is coloniality; pedagogies that encourage new forms of political action, insurgency and cimaronaje while building alliances, hopes and “other” visions of being in society, giving substance and legitimacy to the ethical-political dream of overcoming unjust reality, and building paths “other” (2009, p. 39).

Decolonial Pedagogy “is forged in the perspective of intervening in the reinvention of society, in the politicization of pedagogical action, proposing to unlearn what has been learned and to challenge the epistemic structures of coloniality” (Walsh, Oliveira, & Candau, 2018 p. 6). Hopefully, we can then revitalize ancestral knowledge and its application, not as something of the past, but as the knowledge that is current, and assist Brazilian citizens in reading the world and acting in the present.

## For an education that promotes a more engaged science

The authors Rezende and Ostermann affirm that a science curriculum and its subsequent education needs “to do something,” which can promote different types of student engagement:

In this scenario, the demands of difference, such as gender, ethnicity, region and religion, as examples, are more significant, leading to the defense of a multicultural curriculum that allows rethinking hierarchies and oppressive power relations, breaking with Eurocentric and colonialist systems (Rezende & Ostermann, 2019).

Taking Rezende and Ostermann's words into consideration, it is possible to envision an education that promotes a more engaged science. Content is a means of contributing to necessary social changes and not just an end in itself. The various forms of social injustices present in Brazilian society and Latin America as a whole, in recent years, require us to take a careful look at issues such as teacher education, curriculum, school culture, among others, both in the areas of research, as in basic primary through secondary education, and in the perspective of emancipation.

Finally, the proposition of knowledge more focused on local problems and resistance struggles of social movements can contribute to the countries of the South-Global, in an attempt to rethink and contribute to solutions of Latin American issues and not problems imported from occidental societies. To do so means that in the area of science education, it is necessary to consider the historical and social aspects of the process of production of science and technological knowledge, with the objective of denaturalizing them, problematizing them, shifting their character of neutrality, besides questioning

the alleged essentiality and centrality of science and technology in decision-making processes in the most different social instances. Flavia Rezende and Fernanda Ostermann contribute to scholarship that reaffirms the importance of discussions in our schools and universities, which challenge the view that the final objective of acquiring science knowledge should not be the only objective in science teaching.

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