

The dismantling of the Minas Gerais science curriculum under the mandate of the National Common Core Curriculum

O currículo de ciências mineiro em esfacelamento sob a determinação da Base Nacional Comum Curricular

El currículo de ciencias en Minas Gerais se está desmoronando bajo los dictados del Plan de Estudios Nacional Común

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Abstract

This paper presents the main results of a master's research project whose objective was to analyze, from the perspective of historical-critical pedagogy, the changes in the selection, organization, and systematization of science content in the final years of lower secondary education within the Minas Gerais curriculum, under the determination of the National Common Core Curriculum (BNCC). Based on the theoretical and methodological framework of historical-dialectical materialism and grounded in the critical-emancipatory approach, a comparative documentary analysis was conducted between the science curriculum of the public education system of the state of Minas Gerais prior to the BNCC and the new state curriculum. The

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analysis revealed a reduction and fragmentation of the scientific knowledge prescribed in the new curriculum, as well as an increase in utilitarianism and practicalism in its systematization. This curricular reform thus expresses a deepening of the erosion of critical formative possibilities through the teaching of science in the public education system of Minas Gerais.

Keywords: Science curriculum. Science teaching. Competency-based pedagogy. Education and neoliberalism.

Resumo

O presente trabalho apresenta os principais resultados da pesquisa de mestrado que teve como objetivo analisar, a partir da pedagogia histórico-crítica, as mudanças na seleção, organização e sistematização dos conteúdos de ciências dos anos finais do ensino fundamental no currículo de Minas Gerais, sob a determinação da Base Nacional Comum Curricular – BNCC. Com base no referencial teórico-metodológico do materialismo histórico-dialético e amparando-se na abordagem crítico-superadora, foi realizada uma análise documental comparativa entre o currículo de ciências da natureza da rede pública de ensino do estado de Minas Gerais anterior à BNCC e o novo currículo estadual. Foram constatadas a redução e fragmentação dos conhecimentos científicos previstos no novo currículo, e o aumento do utilitarismo e praticismo na sistematização dos mesmos. Essa reforma curricular expressa, assim, o aprofundamento do esfacelamento das possibilidades formativas críticas por meio do ensino de ciências na rede pública de ensino de Minas Gerais.

Palavras-chave: Currículo de ciências. Ensino de ciências. Pedagogia das competências. Educação e neoliberalismo.

Resumen

Este trabajo presenta los principales hallazgos de una investigación de maestría que tuvo como objetivo analizar, desde la perspectiva de la Pedagogía Histórico-Crítica, los cambios en la selección, organización y sistematización de los contenidos científicos para la educación secundaria en el currículo de Minas Gerais, bajo las estipulaciones de la Base Curricular Común Nacional (BNCC). Con base en el marco teórico y metodológico del materialismo histórico-dialéctico y apoyado en el enfoque crítico-superador, se realizó un análisis documental comparativo entre el currículo de ciencias naturales pre-BNCC del sistema de escuelas públicas del estado de Minas Gerais y el nuevo currículo estatal. El análisis confirmó una reducción y fragmentación del conocimiento científico prescrito en el nuevo currículo, junto con un aumento del utilitarismo y el pragmatismo en su sistematización. Esta reforma curricular refleja, por lo tanto, una profundización en el desmantelamiento de las posibilidades educativas críticas a través de la enseñanza de las ciencias en el sistema de escuelas públicas de Minas Gerais.

Palabras clave: Currículo científico. Enseñanza de las ciencias. Pedagogía basada en competencias. Educación y neoliberalismo.

1. Introduction

Since 2017, the National Common Core Curriculum (BNCC) has regulated the development of state and municipal curricula in Brazil, standardizing the curricular organization of basic education. Under the determinations of this policy, the social function of the school and the guiding curricular axis for the selection, organization, and systematization of knowledge in the school curriculum are grounded in neoproductivism, neopragsmatism, neoconstructivism, and neo–New School pedagogy (neoescolanovismo), combined with competency-based pedagogy (Liporini, 2020). Such pedagogical ideas do not originate in this new curricular education policy, but rather trace back to educational reforms from the late twentieth and early twenty-first centuries. As Pereira and Santos (2008) state:

Following the reorientations introduced by LDB 9394/96, conceptions of curriculum came to be oriented toward the construction of curricular proposals centered on the development of cognitive, motor, and behavioral competencies, understood as requirements of a new stage of capitalism, namely the globalization of the economy. This new stage introduced highly innovative features into the field of educational and curricular policies, as they began to adopt a model of education in which learning to learn became the central emphasis. This implies that education, the school, and the curriculum should be conceived in a more open and flexible manner, not merely as processes of knowledge reproduction, but also as an important space for the production of knowledge. (Pereira & Santos, 2008, p. 74)

This reconfiguration translated into a movement to subordinate the teaching of historically systematized knowledge to the development of skills and competencies. This is the defining feature of the National Common Core Curriculum (BNCC) (Brazil, 2018), whose drafting began in 2012, during the first government of Dilma Rousseff, under the influence, among other social agents, of private apparatuses of hegemony¹, which were consolidating during that period, such as Todos pela Educação² and one of its offshoots, the Movimento pela Base³. This project went through three distinct versions before reaching the version approved in December 2017. The changes in each version referred to elements arising from public consultations and to shifts in the country's political context, with a decisive milestone being the perpetration of the juridical-parliamentary coup of 2016. This event produced conjunctural changes in the correlation of political-economic forces within the state, intensifying the interests of conservative groups, in addition to the already substantial presence of liberal interests (Lagoa, 2019; Piccinini & Andrade, 2018).

This liberal–conservative alliance, marked by a simultaneously pragmatist and belligerently negationist view of scientific knowledge in school education, was expressed in the BNCC through the emptying of content in the teaching of the various fields of knowledge, its fragmentation, and the downgrading of the possibilities for producing a pedagogical reflection capable of objectively explaining reality (Saviani, 2020). In the field of science education, the deepening of the pragmatism characteristic of competency-based pedagogy meant the intensification of a practicitic logic already present in previous curricular policies, such as the National Curriculum Parameters (PCNs) (Malanchen, 2016). Under this logic, science is conceived as a human endeavor characterized by the production of knowledge aimed at problem solving. This conception aligns with the exercise of the intellectual and moral leadership of society by the bourgeois class, insofar as it leads to the formation of a partial and false, because distorted, image of the relations between science and social practice, as well as of scientific production itself.

Based on this reform, the education systems of Brazilian states and municipalities implemented changes in their curricular organization, which constitute the subject of the present study, specifically with regard to the science curricula of the state of Minas Gerais. This state had already had, since 2005, a school curriculum grounded in

¹ Private apparatuses of hegemony are conceptualized here on the basis of Gramsci's conceptions of the integral state and hegemony. They are thus understood as devices for constructing the moral and intellectual leadership of society within the dispute of the class struggle. They are private because they are oriented by the interests of one class or another. (Gramsci, 2001; 2007)

² The current composition of Todos pela Educação can be verified through the following links: <https://todospelaeducacao.org.br/governanca/> and <https://todospelaeducacao.org.br/transparencia/>.

³ The current composition of Movimento pela Base can be verified through the following links: <https://movimentopelabase.org.br/quem-somos/#governanca> and <https://movimentopelabase.org.br/quem-somos/#rede>.

competency-based pedagogy, the Common Basic Curriculum (CBC) (Minas Gerais, 2014), which, after the approval of the BNCC, was restructured, giving rise to the Minas Gerais Reference Curriculum (CRMG) (Minas Gerais, 2018).

In view of the understanding that curricula are documents that synthesize formative intentionalities regarding the type of being, thinking, and acting one seeks to develop for a given social practice, and of the need to carry out an objective analysis of reality in order to make it possible to establish paths toward overcoming the inherently unequal mode of production through which school education is materialized, the following research question was established: what changes occurred in the selection, organization, and systematization of natural sciences content in the curriculum of Minas Gerais under the determination of the National Common Core Curriculum?

The answer to this question is presented on the basis of the results of the master's research, which aimed to analyze, from the perspective of historical-critical pedagogy, the changes in the selection, organization, and systematization of science content in the final years of lower secondary education within the Minas Gerais curriculum, under the determination of the National Common Core Curriculum (BNCC) (Carvalhoes, 2023). Accordingly, the theoretical-methodological and procedural elements through which the research was conducted, as well as the main results and conclusions regarding the object analyzed, are outlined below.

2. Theoretical-Methodological Path

In the research described here, an attempt was made to explain the phenomenon under study based on the materialist, historical, and dialectical conception of reality, grounded in historical-critical pedagogy (PHC) with regard to the understanding of the educational phenomenon. Thus, the study departed from the understanding that school education constitutes a mediating activity of global social practice (Saviani, 2013), which means that, in order to appropriate the mediations that determine it, it is necessary to grasp it in its totality. This elaboration is rooted in the assumption that reality exists in movement, that is, in its ontology; therefore, explaining the materiality of a phenomenon means grasping the fundamental determinations of its movement. In this sense, “[...] method is a means of obtaining certain results in knowledge and in practice,” and, to this end, it must be grounded in knowledge of the objective laws of reality (Kopnin, 1978, p. 91), given that “[...] methods are the procedures based on them (the objective laws) and serve for the successive interpretation and transformation of reality, for the attainment of new results” (Kopnin, 1978, p. 91).

Grounded in Kopnin's (1978) definition and in Marxist theory, it is understood that the “what” and the “how” of what is to be analyzed are intimately articulated facets of the methodological process, since, from a historical-dialectical materialist perspective, form and content are inseparable in the configuration of phenomena in reality. Thus, the research object addressed here corresponds to a given way of investigating it, which must be grounded in the objective laws of reality in order to appropriate the ontological configuration of the phenomenon under study. In this sense, the analysis of phenomena cannot dispense with the categories of mediation, contradiction, and totality (Sandaniel, Rissi, & Ruiz, 2019).

Totality, contradiction, and mediation are ontological categories belonging to the very structure of the real. Only dialectical reason is capable of grasping this reality as it is in itself, reconstructing this movement at the level of consciousness. However, this is not an immediate process. The logical-historical unity between the objectivity of the real and subjective rationality requires a processual movement, achieved through successive approximations (Marsiglia & Lavoura, 2021, p. 196).

This processuality is required because everything that exists is concretized through a dialectical relation among universal, particular, and singular determinations, in which the immediate manifestations and characteristics of the object to be studied, although they constitute its materiality, do not reveal the multiple determinations that explain it in its essence (Lavoura, 2018). The notion of the singular–particular–universal entails the understanding that there is a set of mediations that determine the totality, precisely because every object exists in mediation and relation with other

objects. In this sense, explaining the phenomenon is not simply a matter of describing its characteristics, but of unveiling the relations that determine its form and content.

The analysis conducted in the research thus sought to understand the mediations that determine the existence of the Minas Gerais Reference Curriculum (CRMG), that is, how universal determinants, which are initially abstract, are concretized in its singular expression through the particularities that permeate it. To this end, the CRMG itself and the Common Basic Curriculum (CBC) were taken as the empirical field, in order to establish what changes occurred in the sphere of science education following the implementation of the BNCC. Furthermore, since the educational phenomenon is not defined as closed in itself, the analysis was carried out by establishing relations between political, economic, and social determinants and the text of these documents. Such relations are fundamental because, for historical-critical pedagogy (PHC), school education corresponds to the process of institutionalization of human formation processes in a systematized and intentional manner, which are materialized through different determinants that shape educational work. Among these determinants is the curriculum, which defines the “cultural elements that need to be assimilated by individuals of the human species in order for them to become human and [...] the most appropriate ways to achieve this objective” (Saviani, 2021b, p. 13). Furthermore, considering that:

[...] school education, like everything in our society, is linked to the way in which relations of production are organized in society; therefore, in the present context, it is viscerally connected to the social and economic processes that engender the metabolic reproduction of the capitalist system in which we live” (Lagoa, 2019, p. 3).

The curriculum, therefore, constitutes the organizer of the school activities necessary to carry out the type of formation suited to the social reproduction of capitalism. Under this conception, the curriculum is not merely a list of subjects, but the materiality of the activities defined as central to fulfilling this function of the school. Articulated with this definition, the Coletivo de Autores (1992) developed a didactic-curricular approach, later taken up by Gama and Prates (2020), entitled the Critical-Emancipatory approach, in which the curriculum is conceived as curricular dynamics, since its concrete existence is the synthesis of the treatment of knowledge (the selection, organization, and systematization of the knowledge to be taught in school), school organization, and the regulation of pedagogical activities. The treatment of knowledge, articulated with the other two poles of curricular dynamics, expresses the systematic organization of teaching based on the type of pedagogical reflection one seeks to achieve through educational work, that is, based on what is expected that students will learn about reality through it.

Consequently, in order to explain the changes that have occurred in the science curriculum of Minas Gerais, it is not sufficient to list and describe which contents are present in the current curriculum and how they are distributed and organized; rather, it is necessary to elucidate what these changes reveal in terms of the relations among Brazilian education, science education, and prevailing social practice.

In the present article, the results examined focus on the analysis of the changes in the treatment of knowledge from the CBC to the CRMG. In this regard, the CBC was taken as the document for comparison of the organization of the science curriculum in Minas Gerais prior to the BNCC. In the Minas Gerais Reference Curriculum, the introductory texts, the presentation of the area of knowledge (natural sciences), and its organization by school year were examined. From the Common Basic Curriculum, the texts referring to the area of science were analyzed, since this document was not unitary, but rather consisted of a separate document for each area of knowledge. Previously, the introductory texts and the presentation of the area of knowledge (natural sciences) of the BNCC were read, in view of the articulation of the research with this educational policy. This process was mediated by analyses already carried out by authors affiliated with the theoretical perspective of historical-critical pedagogy and the critical-emancipatory approach (Gama; Prates, 2020; Johann; Malanchen, 2016; Lagoa, 2019; Lavoura, 2021; Malanchen; Santos, 2020; Pina; Gama, 2020; Santos, Orso, 2020; Saviani, 2020).

In the introductory texts and in the presentation of the area of natural sciences, the aim was to identify the form and content of the conception of education and society that guided the educational reforms materialized in the

BNCC and in the CRMG, especially in light of the critiques formulated on the basis of historical-critical pedagogy. Subsequently, the sections of the CRMG and the CBC referring to the organization of the science curriculum from the 6th to the 9th year were analyzed. At this stage, the contents to be addressed were differentiated by year of schooling through the skills and competencies to be developed and the objects of knowledge defined in the documents. Initially, the contents present and absent in each document were delimited by aggregating the contents and objects of knowledge described in the CBC and the CRMG, respectively, into thematic groupings by areas of knowledge within the natural sciences (physics, chemistry, biology). Through this organization, it was possible to quantify the number of themes addressed annually and the number of times they were repeated per year in each curriculum.

After this procedure, the themes common to both documents were examined in detail, in light of the skills corresponding to them in the CBC and in the CRMG, in order to understand how the contents are systematized within them. Based on this organization of the data present in the textual body of the CBC and the CRMG, an effort was made to identify the similarities and differences between these two curricula, taking as an analytical category the treatment of knowledge.

3. The Treatment of Knowledge in the Minas Gerais Science Curriculum under the BNCC's Mandate

The selection and organization of systematized knowledge, as well as the ways of assimilating it in both curricula analyzed, were defined according to the skills and competencies to be developed in the teaching-learning process, a hegemonic element of Brazilian curricular organization since the late 1990s. However, even though the pedagogical conceptions that guide them are the same, the materiality of these documents presents differences. To begin with, there are differences in the criteria for the selection of scientific content and for its organization, which are presented in Table 1.

Table 1 – Criteria for the Selection of Scientific Knowledge in the CBC and the CRMG

Documents	Criteria for the Selection of Scientific Knowledge in the CBC and the CRMG
CRMG (Minas Gerais, 2018, p. 733)	In the Science Curriculum Component, the teaching and learning process may be developed within socially and culturally relevant contexts that enhance meaningful learning. The themes should be flexible and sufficient to explore students' curiosity and questioning, providing the systematization of different contents and their historical development, in accordance with the characteristics and needs of students and of the environment in which they are situated.
CBC (Minas Gerais, 2014, p. 15)	Students frequently experience difficulties in establishing relationships between school science content and situations of everyday life. In addition, they have difficulty making inferences and drawing conclusions from the contributions of these contents to relate to the world and with the world. Thus, when making choices of content topics, it is important to include themes close to students' daily lives and that favor the understanding of basic concepts of science.

Source: Prepared by the author, based on Minas Gerais (2014; 2018).

Both curricula state that the selection of content should be linked to its proximity to students' everyday lives, based on the justification that this articulation with the immediacy of their experience would be necessary to facilitate the teaching-learning process. However, the CBC states that this immediacy favors the understanding of scientific concepts, a term that does not appear in the CRMG excerpt.

In the guidelines for science education in the CBC, the treatment of conceptual content is presented as follows:

The learning of concepts constitutes a fundamental element of science learning. Concepts are our instruments of assimilation. Through them, we interpret and interact with the realities that surround us. On the other hand, this action upon the realities to be interpreted and transformed leads us to constantly revise our concepts, that is, to accommodate them to the new circumstances that present themselves to us. Thus, concepts are modified both in extension and in comprehension. The learning of scientific concepts is a slow and difficult process, since students' prior conceptions usually differ from the central aspects of scientific formulations. The teaching of scientific models and concepts therefore involves planning that allows students to progress from more external aspects of phenomena toward more abstract mechanisms (Minas Gerais, 2014, p. 13)

In addition, "the Content field aims to relate the CBC skills to Science contents in their traditional form, since skills are only developed through work with the contents related to them" (Minas Gerais, 2014, p. 8).

These passages demonstrate the CBC's proximity to teaching through conceptual change, an element linked to constructivist conceptions of education and which has constituted a historical characteristic of curricular proposals for science education since the mid-1960s (Pereira; Campos, 2022). At the same time, in the CBC, as a hallmark of curricular policies since the 1990s, there is a centralization of the appropriation of concepts in the development of skills and competencies. This aspect is linked to the conformation of Brazilian education to neotechnicism, neopragmatism, and neoproductivism, beyond constructivism, insofar as it subordinates, through the overvaluation of practice, the rationale of teaching and its form to the needs of efficiency and productivity suited to the reproducibility of prevailing social practice (Saviani, 2021a).

These elements are characteristic of the earliest trends in curriculum studies, such as Dewey's social progressivism and the perspectives of Bobbitt and Tyler focused on technicism; the latter had a significant influence in Brazil particularly during the 1960s and persisted in curricula throughout the twentieth century. With the BNCC, there is a deepening of the degenerative consequences of these pedagogical and curricular foundations for education in the country (Malanchen, 2016). This is evidenced in the CRMG, as the appropriation of scientific concepts through science education is mentioned only in the early years of elementary education, in the following passage:

In the early years, students will come into contact with scientific language and with the instruments of this field of knowledge, including the basic principles of science, with the minimum concepts for initiation, study, and the construction of scientific knowledge, so that they may appropriate these concepts, as well as their applicability in everyday life (Minas Gerais, 2018, p. 745).

Within the general organization of the curriculum, the objective of science education is linked to the conception of scientific literacy, as described in the following excerpt:

Thus, Science Education is not limited to the presentation of scientific concepts, as in many textbooks, which are generally beyond students' capacity for comprehension. In any case, special attention must be given to scientific literacy so that the curricular component Science does not become a compendium of conceptions devoid of meaning for students (Minas Gerais, 2018, p. 738).

These passages indicate the advance of the secondary positioning of the appropriation of concepts as a function of science education, which, in the CRMG (Minas Gerais, 2018), is articulated with the need to guide teaching toward meaningful learning and with the emphasis on the need for flexibility of content so that students' curiosity and questioning can be explored, which are also hallmarks of constructivism and *escolanovismo* (Duarte, 2004). Thus, while in the CBC the treatment of scientific concepts is emphasized, in the CRMG they are mentioned, within lower secondary education, only to affirm the need to go beyond them so that they do not become merely a conceptual accumulation devoid of meaning for students.

To these criteria is added the definition of the conception of science and of the function of science education delineated in these curricula. In the CRMG, science is defined as a historically constituted enterprise linked to the human need to solve problems, with its teaching enabling the understanding of the "[...] perception of the world not

as an absolute truth, but rather as a process of investigation, of how relations are established, considering that knowing is being able to look at nature and life while understanding the physical, chemical, biological, and social processes in the technological advancement of humanity” (Minas Gerais, 2018, p. 731). And the area of natural sciences is characterized as that which:

[...] addresses scientific knowledge in its physical, chemical, and biological aspects through the investigation of nature in order to critically and analytically interpret observed natural phenomena, resulting from historical, social, and economic relations, with a view to the formation of subjects who act as questioning and transformative agents, aware of their responsibility in relation to natural phenomena (Minas Gerais, 2018, p. 731).

The general skills defined to be developed in this area of knowledge are those related to the procedures of scientific practice, being necessary to “[...] emphasize relations within the scope of life, the Universe, the environment, and technological equipment that may improve and situate students in their world” (Minas Gerais, 2018b, p. 732-733). Furthermore, the function of science education is considered to be:

[...] to cooperate in the transformation of society by addressing the forms of knowledge inherent to it, enabling students to develop skills for the construction, reconstruction, or deconstruction of knowledge, a premise that requires the implementation of a set of approaches that contribute to the formation of questioning and investigative students (Minas Gerais, 2018, p. 737).

As for the CBC:

[...] given the importance of science and technology in our society, it is expected that science education can promote an understanding of what science is and how scientific knowledge affects our relations with the natural world, the built world, and other people. Since science is a cultural production, it represents a cultural heritage of humanity and, in this sense, access to science is a matter of right. In addition, science education should be committed to promoting students’ growing autonomy, aiming at their personal development and providing them with tools for thinking and acting in an informed and responsible manner in a world increasingly permeated by science and technology. To this end, science education should address more general scientific principles as well as technological applications. Scientific concepts and theories do not have value in themselves as abstract systems of thought, but rather as instruments that help us understand the world in which we live so as to guide our actions at the individual and social levels. The science curriculum project must therefore be capable of establishing bridges between natural or technological phenomena and processes, on the one hand, and scientific concepts, models, and theories, on the other (Minas Gerais, 2014, p. 9-10).

In the CRMG (Minas Gerais, 2018), there resonates a conception of an immediate relationship between society and science, with the latter contributing to the transformation of the former; central to this is scientifically literate students, developed through skills that enable them to be questioning and investigative, which is similar to the CBC (Minas Gerais, 2014). However, in the latter, the role of science education is more centrally focused on the appropriation of scientific concepts and on their relations with the natural world and society. It is thus evident that from the CBC to the CRMG there is a deepening of the hegemonic pedagogical ideas responsible for the devaluation of the appropriation of scientific concepts in school education (Saviani, 2021a). From this conception of science and of the function of its teaching follows a given selection of content, as well as its organization and systematization, that is, a given dosage and sequencing of content.

In the CBC (Minas Gerais, 2014) and in the CRMG (Minas Gerais, 2018), the science curriculum is organized into themes, as indicated in Table 2.

Table 2 – General Structure of the CBC and the CRMG

Curriculum Document	General Organization	Themes	Topics
Minas Gerais Reference Curriculum (2018)	Thematic units	Matter and Energy	
		Life and Evolution	
		Earth and Universe	
		Science and Technology	
Common Basic Curriculum (2014)	Curricular axis	Environment and Life	Diversity of life
			Diversity of materials
			Formation and management of soils
			Decomposition of materials
			Water quality and treatment
			Energy and environment
			Evolution of living beings
		Human Body and Health	Body dynamics
			Sexuality
			Interactions of the body with environmental stimuli
		Building Models	Very large world
			Very small world
			Mechanisms of heredity
Science and Technology	Energy transfer processes		
	Energy in environments		

Source: Prepared by the author, based on Minas Gerais (2014; 2018).

The curricular structure of the CRMG is defined by the BNCC, with the subject (curricular component) Science situated within the area of knowledge Natural Sciences and subdivided into four thematic units that are repeated throughout the four final years of lower secondary education and unfold into objects of knowledge, which are to be taught with a view to the formation of skills referred to as learning rights and which vary between the 6th and 9th grades (Minas Gerais, 2018).

As for the CBC (Minas Gerais, 2014), each curricular component includes thematic axes that are repeated each year and are divided into themes. These, in turn, are subdivided into topics in which the contents to be mobilized through the development of the skills defined for each year of lower secondary education are specified. Thus, although there are more subdivisions in the CBC, the format of content distribution is similar to that of the BNCC. However, there is a crucial change in this distribution. In the CBC, skills are developed on a continuous basis each year through the progression of initiating, expanding, and consolidating, which may appear together or separately over the years.

In order to compare the contents present in each document, the “contents” of the CBC and the “objects of knowledge” of the CRMG were aggregated by the author into themes, which refer to knowledge produced by the physical, chemical, and biological sciences, and by fields related to the natural sciences. In terms of content selection, the CRMG (Minas Gerais, 2018), from the 6th to the 9th year, respectively provides for the teaching of eight, nine, nine, and ten themes, whereas the CBC (Minas Gerais, 2014), for the same sequence of years, provides for the teaching of seventeen, fifteen, sixteen, and twenty-one themes. In the new curriculum, at all grade levels, content is reduced to nearly half of the previous number. As for the organization of the remaining knowledge, there is a movement toward greater fragmentation across the final years of lower secondary education. In the CRMG, no theme is present across all four grades, and only two are repeated in three years, whereas in the CBC, ten themes are repeated in three or more grades. In this sense, it can be observed that the CRMG is a more vertical curriculum than the CBC.

Furthermore, there is the question of which contents were retained, which were added, and which were excluded in the transition from the CBC to the CRMG. There are 21 themes that were retained in the CRMG in comparison with the CBC. The themes that were excluded and those that were added are presented in Table 3.

Table 3 – Themes Excluded from and Inserted into the CRMG in Comparison with the CBC

Area of knowledge	Excluded themes	Inserted themes ⁴
Biology	Parasitology,	Public Health
	Plant Anatomy and Physiology	Biotechnology
	Biochemistry	
Chemistry	Water	Radioactivity
	Periodic Table	
	Pressure	
Physics	Optics	Thermodynamics
	Acoustics	
	Mechanics	
	Kinematics	
	Temperature	

Source: Prepared by the author, based on Minas Gerais (2014; 2018).

Furthermore, in both documents there is a single theme that encompasses the three areas of the natural sciences: scientific and technological knowledge. It is present in all years in the CBC and only in the 6th, 7th, and 8th years in the CRMG. In both, the prescribed contents concern the production of scientific knowledge, technologies, and the concept of sustainability; however, their level of detail is greater in the CBC than in the CRMG. In the 6th year, for example, the following contents were to be addressed: the production of scientific knowledge and its implications for humanity and the environment; the role of science and technology in everyday life; scientific and technological innovations (their importance for agriculture and industry, benefits and harms); the use of technological resources in water treatment and soil cultivation; recycling and environmental preservation; and waste production. In the CRMG, by contrast, the contents are described only as scientific knowledge and sustainability.

The data show that there was a reduction in scientific knowledge and an increase in the fragmentation of the curricular organization of the CRMG in relation to the CBC, which means that, in the new curriculum, contents constitute science education in a punctual manner. As a result, the objective of science education leading to the appropriation of the internal nexuses of natural phenomena becomes less likely to be developed, as does the development of the intellectual capacity for apprehension, interpretation, understanding, and explanation of objective reality.

Furthermore, within the themes, the contents and objects of knowledge that gave rise to the themes themselves are found, as well as the skills to be developed through them. This made it possible to identify how content is systematized in these curricula, that is, how the “[...] explanation of regularities and of the internal nexuses of knowledge, the essential traits of objects and phenomena” is carried out in these documents (Gama; Prates, 2020, p. 84). In other words, through the defined skills it was possible to identify the quality of the pedagogical reflection carried out by the CBC and the CRMG, that is, what is expected that students will learn about reality through science education.

The centrality of the formation of skills and competencies as the guiding principle for defining the treatment of knowledge is a fundamental factor in the systematization of content in these curricula, precisely because it defines the final objective of the socialization of scientific content. The criteria for content selection and the definition of the role of science education in these curricula help to specify the characteristics of this systematization in the two documents.

In the CRMG (Minas Gerais, 2018), the main criterion for the treatment of knowledge is the formation of meaningful learning, to which is articulated the need for knowledge flexible enough to adapt to students’ specific realities and interests, whereas in the CBC (Minas Gerais, 2014), although the treatment of knowledge is also

⁴ Although these five themes are not explicitly stated in the CBC, they can be addressed through other themes present in the curriculum, such as parasitology, microbiology, cytology, genetics, atomistics, temperature, and pressure.

subordinated to the immediate needs of students, the formation of concepts appears as an important criterion. Furthermore, in the CRMG the role of science education is to contribute to the transformation of society through the formation of questioning and investigative subjects, and in the CBC the role of science education is to enable students to know what science is, what its implications are for the relationship of human beings with nature, with society, and with themselves, enabling responsible actions in a world highly permeated by science and technology, which is linked to the perspective of scientific literacy.

Even though both curricula are linked to a pragmatist conception of content, there is a fundamental divergence between them when it comes to the process through which science education can contribute to the formation of actively participatory subjects in society⁵. The CBC assigns central importance to the formation of concepts so that the skills and competencies necessary for scientific literacy can be developed, whereas in the CRMG the central criterion is grounded in a more explicitly subjectivist perspective on the importance of scientific knowledge, by excluding work with concepts and giving centrality to the immediate experiences and realities that students confront in defining what should be taught in science. This difference is expressed in the way contents appear in these curricula, beyond their mere presence or absence across the years of schooling.

Although the CRMG does not have the same sequencing of skills by year, in 12 of the themes shared by the two curricula (classification of living beings, genetics, evolution, sexuality, geology, human anatomy and physiology, properties and composition of air, substances and mixtures, chemical reactions, astronomy, heat, electricity, and scientific and technological knowledge) there are similar skills to be developed. These similarities appear either in the wording of the skills or in the concepts to be addressed through the skills within each theme. At the same time, among these themes, there are also differences with regard to the skills. In the CRMG, there is an accentuation of pragmatism and utilitarianism through the wording of the skills, as shown in the example below.

In the genetics theme, the following skill is described in the CBC: “analyze Mendel’s work on the transmission of hereditary traits and the possibility of their manifestation in alternating generations (Mendel’s First Law)” (Minas Gerais, 2014, p. 68). In the CRMG, in turn, this skill is modified to “[...] discuss Mendel’s ideas on heredity (hereditary factors, segregation, gametes, fertilization), considering them in order to **solve problems** involving the transmission of hereditary characteristics in different organisms” (Minas Gerais, 2018, p. 774, emphasis ours).

The wording of this skill centers the rationale for studying the concepts of Mendelian genetics on the resolution of problems that require such knowledge. Although knowledge has importance insofar as it mediates the understanding of reality and indirectly informs action in the world, this skill does not concern an action guided by the appropriation of concepts. As discussed by César Santos (2012), science education oriented toward problem solving is articulated with a conception of science that breaks with the theory–practice axis, rendering scientific production subordinate to an emptied and technicist practice; and, considering the epistemological determinants that guide the formulation of the normative educational policy of the CRMG, this is the meaning that the term “solving problems” assumes in this skill.

Pragmatism and utilitarianism also permeate the skills that differ across the themes common to the CBC and the CRMG. In the energy theme, for example, the only skill described in the CRMG is “[...] identify and classify different sources (renewable and non-renewable), the types of energy used in homes, communities, or cities, and analyze the environmental impacts generated,” subordinating an entire body of knowledge to its mere utility for society (Minas Gerais, 2018b, p. 768-769). In the CBC, by contrast, four skills are described, which allow the relations between energy and society to be debated, but do not restrict the level of pedagogical reflection to energy that is usable by humanity in its immediate everyday life.

These examples can be analyzed in light of what Duarte (2016) proposes as the “planned obsolescence of knowledge,” drawing a parallel with the planned obsolescence of consumer goods under neoliberal development in

⁵ Actively participatory is understood here as meaning adequately shaped to the immediate needs of capitalist society, since both documents are linked to non-critical pedagogical conceptions.

capitalism. The author argues that, just as products resulting from this mode of production have increasingly shorter periods of validity and usefulness due to the speed with which new consumer demands and needs are created by the market, knowledge, within this form of sociability, “is considered a good for immediate consumption, which quickly becomes obsolete” (Duarte, 2016, p. 2). The following excerpt from the CRMG regarding the criteria for the selection of scientific content evidences the author’s analysis by centering the teaching–learning process on students’ immediate and individual experiences, namely: “the themes should be flexible enough to explore students’ curiosity and questioning, providing the systematization of different contents and their historical development, in accordance with the characteristics and needs of students and of the environment in which they are situated” (Minas Gerais, 2018, p. 733).

The wording of the skills in the science curriculum of the CRMG (Minas Gerais, 2018), in comparison with the curriculum prior to the BNCC, makes it possible to affirm an intensification of the process of planned obsolescence of scientific knowledge in the current Minas Gerais curriculum. Through the analysis of the skills, additional contents that were excluded in the CRMG were also identified. These are: sexual and asexual reproduction, menstrual cycle, weathering, energy flows in ecosystems, excretory system, reproductive system, hearing, health and illness, adolescence, atomic characteristics of matter, the provisional nature of scientific knowledge, and waste. In addition, other contents were identified that appear in the skills of the CRMG and are not explicitly present in the CBC. This is the case of the study of cellular organelles, cell division, theories of the origin of life, biogenesis and abiogenesis, vaccines, dimensions of human sexuality, tectonism, layers of the Earth, the greenhouse effect, the ozone layer, climate, the muscular system, the skeletal system, balancing of chemical reactions, thermodynamics, digital technologies, tissues, and atomic models. The latter two, although they do not have corresponding skills described in the CBC, are provided for as contents to be studied.

In complementarity to this, the comparison between the skills in the two documents shows that the CRMG brings into the curriculum a greater number of discussions that relate science, society, technology, and the environment. The skills involving the geology theme in the CBC, for example, do not specify, as in the CRMG, anthropic actions responsible for solving or aggravating environmental destruction. At first glance, this specificity of the CRMG regarding the relations among society, science, technology, and the environment may appear positive, in the sense of contributing to the “transformation of society” envisioned as a function of science education in this curriculum. However, as shown by the following skills: “[...] propose individual and collective initiatives to solve environmental problems in the city or community, based on the analysis of successful actions of conscious consumption and sustainability” (Minas Gerais, 2018, p. 775), and “[...] identify the technological resources used in water treatment and soil cultivation aimed at sustainable development and entrepreneurial culture” (Minas Gerais, 2018, p. 763), an individualistic perspective underlies the CRMG with regard to the possibilities of transforming society, in view of the resolution of environmental problems and, more broadly, social problems. Thus, the background of these proposals is not the effective transformation of society, but rather the humanization of capitalism.

The perspective that conscious action, made explicit in the term “conscious consumption” or in the use of technologies in water treatment and soil cultivation, leads to the resolution of environmental problems is erroneous, as it is partial with regard to the analysis of the factors that led, in the first place, to the emergence of environmental problems. With regard to the use of water resources and their preservation, for example, science education cannot dispense with presenting that individual actions, although necessary, are not capable of solving the issue of water scarcity in light of the destruction of water resources. Data from the National Reference Base of Consumptive Water Uses in the country help to substantiate this argument, as water consumption for urban supply, in the historical sequence from 1970 to 2020, remained constant at around 24%, while combined use for irrigation, animal use, industry, and mining increased from 61.1% to 69.7% over fifty years (Agência Nacional de Águas e Saneamento Básico, 2023). Considering that these productive sectors operate under the imperatives of a mode of production centered on capital accumulation through the exploitation of workers and the environment, these data show that saving water at the domestic level proves ineffective in comparison to water use in industry, mining, and agribusiness. This is especially

so given the projected growth of these uses to 74.6% over the next twenty years, while projections for urban supply indicate a decrease to 19.5% by 2040 (Agência Nacional de Águas e Saneamento Básico, 2023). In other words, the solution to the problem of water scarcity necessarily involves questioning and transforming the way in which what we consume is produced, from food to housing and other material goods.

The CRMG, by failing to present the complexity of mediations that cause environmental destruction, especially the capitalist productive structure, while at the same time positing this partial perspective as a solution, is taking a side: the side of conforming to the conditions that generate the very problems it claims to help transform. Furthermore, it is important to highlight a skill in the CRMG belonging to the sexuality theme, which proposes “[...] selecting arguments with scientific bases that demonstrate the multiple dimensions of human sexuality (biological, sociocultural, affective and ethical) with the aim of promoting inclusion and combating prejudice” (Minas Gerais, 2018b, p. 770). Combating LGBTQIA+phobia is necessary, and the presence of a specific skill to address this issue in the new Minas Gerais curriculum apparently constitutes an advance in relation to the previous curriculum. However, it is necessary to ask: will the development of this skill, that is, having arguments with scientific bases that demonstrate the multiple dimensions of human sexuality, effectively lead to inclusion and eliminate prejudice against this community? In other words, does developing this skill contribute to the end of LGBTQIA+phobia and to the realization of a society that is effectively plural, diverse and egalitarian?

Developing a skill or competency to discuss the existence of multiple dimensions of human sexuality is not the same as establishing the foundations for their construction. Skills and competencies are the capacity to act in response to specific demands; however, if there is no content that leads to their development, how is one to act? In the CRMG, content on the menstrual cycle and the reproductive system is not taught, even though these involve biological and sociocultural dimensions. The absence of these contents, which are fundamental for understanding the functioning of the human body, does not eliminate the possibility of debating the historical and social issues that traverse the constitution of human sexuality; however, within the scope of science education, its specificity as an area of knowledge constitutes the core contribution that can lead to the construction of an egalitarian, free, and just society. Without encompassing the historicity and materiality of content, teaching is flawed and insufficient, but without content, teaching is impossible. This discussion is valid for all other skills that propose, through them, to contribute to social, environmental, political, and other forms of transformation.

For this reason, it is necessary to emphasize that, although the skills in the CRMG explicitly address issues involving relations between science, society, technology, and the environment, the emptying of content and its fragmentation across the four final years of lower secondary education hinder the realization of the potential these relations hold for enabling a richer reading of the social practice within which nature and science are constituted.

The knowledge historically produced by scientific practice, and the concepts that emerge from it, are traversed by political, social, economic, and ideological factors of the time and space in which they were developed, and even when immersed in an interested and non-neutral practice, they can be understood as objective knowledge, given the dialectical relationship between subjectivity and objectivity that is intrinsic to scientific practice (Saviani, 2021b). That is, even though modern science is articulated with the early development of the capitalist mode of production and structured within the sociability of this society, its knowledge, insofar as it contributes to the objective explanation of concrete reality, carries the potential to lead to a richer and deeper understanding of the world.

However, this potential does not materialize if scientific concepts are presented as inert, isolated, static forms of knowledge, detached both from the historical process that produced them and from their own historicity and materiality as reflections of the real movement of nature. It is in this sense that the incapacity of the treatment of knowledge expressed in the CRMG to lead to the formation of critical consciousness and to contribute to the possibilities of genuine social transformation is affirmed here.

Science education that can contribute to the radical transformation of society is that in which the mediation of the teaching–learning process takes place through historicized scientific knowledge, understood as a reflection of

objective reality that is historical, dialectical, and materially determined, that is, in relation to social practice. For it is the unveiling of these relations that leads to the transformation of students' subjectivity and, indirectly, to some contribution to their way of acting on and within reality (Carvalhaes, 2023).

5. Conclusions

In accordance with the Marxist tradition, especially on the basis of Gramscian formulations, historical-critical pedagogy understands that the possibilities for education to contribute to the class struggle toward overcoming the capitalist mode of production lie in the development of an educational practice that forms ways of thinking, feeling, and acting guided by an objective reading of reality. Under Marxist assumptions, this requires the appropriation of the multiple theoretical-practical determinations that explain the historical movement of reality. These determinations, under capitalist social practice, and especially within an educational context marked by the neoliberal project of sociability, tend to be erased and rendered partial through everyday social reproduction. For this reason, for historical-critical pedagogy, the primary function of school education must be the socialization of historically produced knowledge to the children of the working class, with the aim of contributing to the process of elevating this class to a class for itself.

The results of the master's research (Carvalhaes, 2023) presented here demonstrate, within the scope of the school curriculum of the final years of lower secondary education in Minas Gerais, a process of dismantling the conditions through which science education could contribute to the fulfillment of this function. Through the reduction, fragmentation, and subsumption of school content to a pragmatist and utilitarian form of science, the Minas Gerais curriculum, which prior to the BNCC already enacted a conception of reality reduced to practice as a whole separated from theory, radicalizes this process, transforming systematized knowledge into dispensable appendices or into elements deemed useful according to the needs of an increasingly alienated social practice under the consolidation of the neoliberal project of sociability.

Here, an effort was made to contribute, from a critical pedagogical framework, to the composition of an unveiling of Brazilian educational reality under the BNCC. The explicit presentation of this movement, however, is not intended to demonstrate the closure of possibilities for the construction of a radically critical education, but rather to offer theoretical-practical elements for opening up this possibility. To this end, there is a need, in future research, to expand the analysis of Minas Gerais curricular dynamics beyond the treatment of knowledge, seeking to investigate their materiality in concrete school educational practice.

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