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Indigenous knowledge and science teaching: Law 11,645/08 in the dynamics of ethnic-racial relations

ARTICLE

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Abstract
This article presents an integrative systematic review of Brazilian theses and dissertations on the implementation of Law nº 11.645/08 in Science Education, focusing on Indigenous knowledge and interculturality. Sixteen works available in the Brazilian Digital Library of Theses and Dissertations were analyzed according to thematic and methodological criteria. The study is grounded in the theoretical frameworks of interculturality, decoloniality, and ethnoscience, which guide the analysis of practices and curricula. The results indicate that the Law has been mobilized as both a legal and pedagogical instrument for valuing Indigenous knowledge and for re-signifying educational practices. While experiences related to biology and ecology are predominant, innovative proposals addressing chemistry and astronomy are also highlighted. Teacher education and the production of intercultural materials remain central challenges for the Law's effective implementation. It is concluded that, despite progress, its application is still uneven, requiring public policies that promote a critical and anti-racist science education.
Keywords: Intercultural Education. Science Teaching. Educational Legislation. Literature Review.

Saberes indígenas e ensino de ciências: a Lei 11.645/08 na dinâmica das relações étnico-raciais

Resumo
Este artigo apresenta uma revisão sistemática integrativa de teses e dissertações brasileiras sobre a aplicação da Lei nº 11.645/08 no ensino de ciências, com foco na temática indígena e na interculturalidade. Foram analisados 16 trabalhos disponíveis na Biblioteca Digital Brasileira de Teses e Dissertações, à luz de critérios temáticos e metodológicos. O estudo está fundamentado em referenciais da interculturalidade, da decolonialidade e da etnociência, que orientam a análise das práticas e dos currículos. Os resultados indicam que a lei tem sido mobilizada como instrumento legal e pedagógico para valorização dos saberes indígenas e a ressignificação das práticas educativas. Embora predominem experiências vinculadas à biologia e ecologia, propostas inovadoras com conteúdo de química e astronomia são evidenciadas. A formação docente e a produção de materiais interculturais seguem como desafios centrais à efetivação da lei. Conclui-se que,

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apesar de avanços, sua aplicação ainda é desigual, exigindo políticas públicas para uma educação científica crítica e antirracista.
Palavras-chave: Educação Intercultural. Ensino de Ciências. Leis do Ensino. Revisão de Literatura.

1 Introduction

Although Brazil officially recognizes itself as a nation marked by ethnic and cultural plurality, this acknowledgment has not historically translated into the equitable valuing of its formative roots. The Afro-Brazilian and Indigenous heritages, though fundamental to the constitution of the national identity, were systematically neglected, occupying secondary positions in official discourses and educational policies (Vasconcelos; Alves, 2024). When eventually included in school curricula, these cultures were often represented in a stereotyped or folklorized manner, reinforcing exotic images and keeping these so-called "dominated identities" distant, while the foundational myths of the nation exalted the "dominant identities," generally associated with the white, European, and Western matrix (Silva, 2003; Munanga, 2005; Candau, 2012). This exclusive curricular logic contributed to the reproduction of symbolic and social asymmetries, silencing the knowledge and epistemologies of historically marginalized peoples.

In order to address this exclusion, Law No. 11,645/08 amends articles 26-A and 79-B of the National Education Guidelines and Framework Law (LDB), making the inclusion of Afro-Brazilian and Indigenous history and culture mandatory in the official curriculum of basic education in public and private schools. The legal text states:

> § 1 The curricular content referred to in the *caput* of this article shall include the study of the history of Africa and of Africans, the struggle of Black and Indigenous peoples in Brazil, Black and Indigenous Brazilian culture, and the role of Black and Indigenous peoples in the formation of the national society, recovering the contribution of Black and Indigenous peoples in the social, economic, and political areas pertinent to the history of Brazil (Brasil, 2008).

This principle is reinforced in the 2018 National Common Curricular Base (BNCC), which establishes the valuing of diversity as one of the central commitments of Brazilian

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education. In the field of Natural Sciences, the BNCC posits that science teaching must enable students to understand the natural and technological world based on scientific knowledge and respect for the diversity of knowledge, contributing to the exercise of citizenship and valuing the ethnic-cultural diversity of individuals and social groups, without prejudice of any nature (BNCC, 2018, p. 324-327).

Thus, the advent of Law No. 11,645/2008 (Brasil, 2004; 2008) was a major advance in the deconstruction of stereotypes about diverse Indigenous populations, breaking with the images of folkloric roles, the idea of extinction, or the conception that they would only be those who live isolated in remote forests. Regarding the Afro-Brazilian population, the law also contributes to shattering narratives that exclusively associate the Black presence with slavery, thereby silencing their knowledge, resistance, and contributions across different fields of society. By including this knowledge in school curricula, the legislation seeks to promote a more equitable, anti-racist, and plural education, valuing historically marginalized identities and expanding possibilities for student recognition and belonging (Borges; Silva, 2022). In this way, the construction of historical and cultural redress in relation to Indigenous and Afro-Brazilian peoples demands more than just legal changes: it requires continuous processes of debate, critical reflection, and re-signification, both in academic spheres and in society at large. According to Luciano (2006), it is important to recognize and value the contributions of the original peoples to the formation of the Brazilian identity, overcoming views that relegate Indigenous cultures to a distant and static past. This perspective still persists in the social imaginary, even in the face of the constitutional advances of 1988 (Brasil, 1988), which ensure specific rights to Indigenous peoples, and educational policies such as Law No. 11,645/08, which seeks to integrate these voices into school curricula (Angêlo, 2019; Cerqueira; Lima, 2024).

The mandatory insertion of ethnic-racial themes into the school curriculum, as provided for in Law No. 10,639/2003 and expanded by Law No. 11,645/2008, extends to higher education, with special emphasis on licentiate degree programs (teacher training), which are responsible for the formation of basic education teachers. CNE/CP Resolution No. 01/2004, in its Article 1, mandates that the guidelines for the education of ethnic-racial

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relations and the teaching of Afro-Brazilian and African history and culture must be compulsorily observed by all educational institutions, especially those that maintain initial and continuing teacher training programs (Brasil, 2004).

Thus, licentiate degree programs must incorporate courses, content, and pedagogical practices focused on valuing Black and Indigenous identities, as well as on a critique of the historical processes of exclusion and silencing of these groups. CNE/CP Opinion No. 3/2004 reinforces this perspective by stating that teacher training needs to prepare future educators to act competently in the confrontation of racism and the promotion of anti-racist education, through the systematic inclusion of content that addresses ethnic-racial relations and cultural plurality, determining in Article 1, Paragraph 1, that:

> § 1 Higher education institutions, while respecting their due autonomy, shall include the Education of Ethnic-Racial Relations, as well as the treatment of issues and themes concerning Afro-descendants, in the content of the courses and curricular activities of the different programs they offer, in the terms detailed in CNE/CP Opinion 003/2004 (Brasil, 2004).

However, despite the legal and normative clarity, studies and experiences (Canen; Xavier, 2011; Ângelo, 2019) point to the fragility in the implementation of this guideline in higher education. Many institutions still treat the theme peripherally, through elective courses, or as isolated content points within broader curricular components. This gap directly affects the quality of teacher training and compromises the effectiveness of the application of Laws 10,639/03 and 11,645/08 in schools.

Given this context, the importance of rethinking licentiate degree curricula is evident, to ensure that future educators are familiar with the legal content and develop a historical, social, and epistemological understanding of Afro-Brazilian and Indigenous cultures. This is essential for effectively contributing to a more diverse and anti-racist education, encouraging research on the topic, and developing skills that contribute to the advancement of ethnic-racial relations in education (Vasconcelos; Alves, 2024). Generally, this legislation represents a significant advance in the pursuit of a more plural and inclusive education by recognizing ethnic-cultural diversity as an essential part of Brazilian students'

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formation. Nevertheless, the enforcement of this law has faced challenges, ranging from teacher training to the development of didactic materials that adequately and respectfully address the contributions of Afro-Brazilian and Indigenous cultures (Gaudêncio; Silveira; Martins, 2025).

The field of ethnoscience, which encompasses the traditional knowledge of different ethnic groups about natural phenomena and their interactions with the environment, offers a promising avenue for science teaching under a decolonial perspective. The decolonial approach questions the Eurocentric paradigms dominant in the production and dissemination of knowledge, valuing local and traditional knowledge as legitimate and complementary to scientific knowledge. In this context, science teaching can contribute to a more critical education aligned with the sociocultural reality of the students.

According to Gaudêncio, Silveira, and Martins (2025), teachers face difficulties in finding methodological guidelines for the effective application of this theme, specifically in scientific disciplines. Given this scenario, the objective of this study is to conduct a systematic review of the academic production (Brazilian theses and dissertations) that addresses the implementation of Law No. 11,645/08 in science teaching, with a focus on Indigenous culture. The proposal is to map and analyze how this theme has been addressed in academic research, identifying trends, methodologies, gaps, and challenges in applying the law and promoting a more inclusive and culturally contextualized science and technology education. Thus, we have the following guiding question: "In what ways has Law No. 11,645/08, with emphasis on the Indigenous theme, been addressed in theses and dissertations on science teaching in Brazil, considering methodological, theoretical, and contextual aspects?".

To answer this question, a systematic literature review was used as the methodology, as this type of approach allows for an organized analysis of the state of the art on the topic. Furthermore, the decision was made to prioritize complete academic works, such as theses and dissertations, based on the understanding that these documents offer an in-depth and detailed view of the research processes, the theoretical frameworks used, the methodological choices, the results, the theoretical trends, the problems, and

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limitations, among other aspects legitimized in academic productions of a given research area (Motin et al., 2019). Unlike abstracts or isolated articles, these productions enable a more robust analysis of how Law No. 11,645/08 has been applied in science teaching, especially concerning the valuing of ethnoscience and decolonial perspectives. This methodological choice therefore seeks to map the existing production and understand how the pedagogical practices and challenges faced in the enforcement of the aforementioned legislation are materialized across different academic contexts.

2 Methodology

The methodological approach was based on the study by Coelho, Oliveira, and Almeida (2021) and is grounded in a systematic bibliographic literature review with an integrative approach (Mendes; Silveira; Galvão, 2008), following the steps and their respective objectives, as established by Botelho, Cunha, and Macedo (2011): Stage i: identifying the theme and selecting the hypothesis or research question for the elaboration of the integrative review; Stage ii: establishing criteria for the inclusion and exclusion of studies/sampling or literature search; Stage iii: defining the information to be extracted from the selected studies/categorization of studies; Stage iv: categorization of the selected studies: developing and using the synthesis matrix; categorizing and analyzing the information; forming an individual library; critically analyzing the selected studies; Stage v: analysis and interpretation of the results; Stage vi: presentation of the review/synthesis of knowledge.

With the purpose of organizing and structuring the methodological **operationalization** of this study, a systematic review research form (Table 1) was developed, according to the adapted model from Coelho, Oliveira, and Almeida (2021).

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Table 1 - Systematic Review Research Form on the Implementation of Law No. 11,645/08 in Science Teaching, with a Focus on Indigenous Ethnoscience

Content	Explanation
Research Objective	To map and analyze how interculturality in science teaching has been addressed in academic research, identifying trends, methodologies, gaps, and challenges in the application of Law No. 11,645/08 and the promotion of a more inclusive and culturally contextualized scientific education.
Research Equation to be Applied	(1) with keywords: Law 11,645/08, Indigenous culture, and science teaching. (2) with keywords: Law 11,645/08, interculturality, and science teaching.
Research Scope	The research will be conducted in the database of the Digital Library of Theses and Dissertations (BDTD), searching all fields and term matches.
Inclusion Criteria	Theses and dissertations defended in *stricto sensu* graduate programs, studies available in full text, studies that address Law No. 11,645/08 with a focus on science teaching, research involving Indigenous themes in the field of scientific education, and works that mention or engage with ethnoscience or decolonial perspectives.
Exclusion Criteria	Works that address Law No. 11,645/08 without relation to science teaching, duplicate productions (e.g., the same work listed in different databases), abstracts or incomplete documents (without access to the full text), and works focused exclusively on the Afro-Brazilian matrix, without mention of Indigenous culture.
Criteria for Quality and Methodological Validity	Aspects considered in the analysis included: clarity and coherence in the formulation of research objectives and questions; consistency between the objectives, the adopted methodology, and the presented results; adequate theoretical foundation on interculturality, ethnoscience, and/or science teaching; description of methodological procedures; justification for the utilization of Law No. 11,645/08; and coherent analysis of the data.

Source: The authors (adapted from Coelho, Oliveira, and Almeida, 2021).

2.1 Research Stages

(i) Definition of the Guiding Question**:** In what ways has Law No. 11,645/08, with emphasis on the Indigenous theme, been addressed in theses and dissertations on science teaching in Brazil, considering methodological, theoretical, and contextual aspects?

(ii) Location of Works: This study focuses on theses and dissertations, considering that these works tend to present greater methodological depth and detail of results compared to journal articles and communications at scientific events. The search was conducted in the Brazilian Digital Library of Theses and Dissertations (BDTD) of the Brazilian Institute of Information in Science and Technology (IBICT), using the following keywords: “Law 11,645/08”; “science teaching”; “Indigenous culture”; and “interculturality.” After the initial selection of works, a complete reading of the texts was performed to ensure they met the established inclusion criteria. Inclusion Criteria: Theses and dissertations

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defended in *stricto sensu* graduate programs, studies available in full text, studies that address Law No. 11,645/08 with a focus on science teaching, research involving Indigenous themes in the field of scientific education, and works that mention or engage with ethnoscience or decolonial perspectives.

(iii) Exclusion Criteria: Works that address Law No. 11,645/08 without relation to science teaching, duplicate productions (e.g., the same work listed in different databases), abstracts or incomplete documents (without access to the full text), and works focused exclusively on the Afro-Brazilian matrix, without mention of Indigenous culture.

(iv) Organization, Archiving, and Coding: The selected works were identified and coded (T1, T2, D1, D2...) to facilitate the analysis and categorization of the results.

(v) Descriptive Analysis: The results were organized into tables, considering the following criteria: names of the researchers and involved institutions; geographical location and research context; educational level addressed (elementary school, secondary school, higher education); research methodologies employed; main challenges and solutions identified in the implementation of Law No. 11,645/08.

(vi) Interpretive Analysis: The results were analyzed, seeking articulation with the theoretical assumptions of ethnoscience and the perspective of Law No. 11,645/08, with the aim of identifying the challenges and advances in promoting a more inclusive and culturally contextualized education.

The BDTD platform was chosen because it gathers full-text works, in addition to offering advanced and detailed search tools, allowing for the use of different types of metadata, a feature that is not available on other platforms, such as the CAPES theses and dissertations platform. Accessing the platform's homepage, the "Advanced Search" option was selected to access the information base, filling three available search fields with different descriptors related to the object of study, inserting two search equations: (1) with the keywords “Law 11,645/08, Indigenous culture and science teaching”; (2) with the keywords “Law 11,645/08, interculturality and science teaching,” using the Boolean operator “AND.” The platform indicated a total of 132 works (16 theses and 116

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dissertations) in search (1), and 48 (7 theses and 41 dissertations) in search (2), totaling 180 initial records.

Using the feature provided by the BDTD platform itself, two Excel spreadsheets were generated with general information about the research, such as authors, title, abstract, keywords, year of publication, institution, and type of material (dissertation or thesis). Subsequently, the two spreadsheets with the collected results were unified, which allowed for the systematization of the corpus and the elimination of duplicate works, thus totaling 114 research entries found. For the analysis of the corpus, Discursive Textual Analysis (DTA) was employed, following the stages described by Moraes and Galiazzi (2011), which include: (a) deconstruction and unitarization, in which the corpus is read in a detailed and meticulous manner, being subsequently fragmented into units of meaning based on the author's interpretation; (b) categorization, which consists of grouping the significant units according to the explicit and implicit meanings identified; and (c) metatext, a phase in which the categories are developed and an integrating text is elaborated, with the objective of offering a broad and coherent understanding of the themes addressed. In summary, after the systematic search on the BDTD platform, a total of 114 works were identified. However, many of them were not directly related to the implementation of Law No. 11,645/08 in science teaching, ethnoscience, and/or interculturality. Therefore, after applying the inclusion and exclusion criteria, 16 works were selected to integrate the research corpus, which underwent a detailed analysis.

3 Results and Discussion

3.1 Studies on the Application of Law 11,645/08 in Science Teaching: A Corpus Overview

Following the use of the descriptors and the reading of the abstracts of the works that comprise the corpus, research was detected whose focus of investigation did not converge with the aims of this study and/or did not meet the inclusion, quality, and methodological validity criteria defined *a priori*. Thus, a set of 16 works (3 theses and 13

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dissertations) was reached to compose the scope of analysis for this research. The works were coded for systematization: the author's surname, year of publication, and an identifier code, such as: Gorri (2020 – T1), (Coelho; Oliveira; Almeida, 2021).

In this manner, the collection is composed of:

a) Theses: Gorri (2020 – T1); Gaudêncio (2022 – T2); Florêncio (2022 – T3); b) Dissertations: Nascimento (2010 – D1); Ferreira (2011 – D2); Gonçalves (2019 – D3); Moraes (2019 – D4); Gonzaga (2020 – D5); Pachon (2021 – D6); Santos (2022 – D7); Alves (2022 – D8); Souza (2022 – D9); Jacques (2023 – D10); Ribeiro (2023 – D11); Ribeiro (2023 – D12); Gonçalves (2024 – D13).

Table 2 presents the identification of the selected theses and dissertations, and Table 3 provides a general overview of the categories analyzed in each of the studies.

Table 2 - Theses and Dissertations Selected for the Research Corpus

Code	Author	Title	Program/ Institution	Year
T1	Gorri, Ana Paula	Perspectives on Law No. 11,645/2008 in Chemistry Teacher Education in Santa Catarina and the Potentialities of Non-Formal Education Spaces.	PhD / Federal University of Santa Catarina	2020
T2	Gaudêncio, Jéssica Da Silva	Kaingang Indigenous Knowledge: Historiography, Ethnoscience, and Scientific Education.	PhD / Federal Technological University of Paraná	2022
T3	Florêncio, Roberto Remigio	Indigenous and Intercultural Education in the Opará Villages: A Society of Silenced Subjects.	PhD / Federal University of Bahia	2022
D1	Nascimento, Maria Rosemi Araújo Do	Intercultural Education and Science Teaching: Construction of Natural Science Concepts at the EIBC - Pamaáli Indigenous School, in Alto Rio Negro.	Master's Degree / State University of Amazonas	2010
D2	Ferreira, Edmilza Dos Santos	The Teaching of Natural Sciences: An Intercultural Proposal in Multi-grade Early Years at the Aleixo Bruno Municipal School in the Terra Preta Indigenous Community.	Master's Degree / State University of Amazonas	2011

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D3	Goncalves, Jacqueline Castro	Indigenous Narratives in Early Elementary School: What Do the Didactic Materials Say?	Master's Degree / Federal University of Minas Gerais	2019
D4	Moraes, Carlos Eduardo Ferraz	Astronomy Teaching Considering Law 11,645/08: Contributions of Brazilian Indigenous and African Cultures.	Master's Degree / Federal Fluminense University	2019
D5	Gonzaga, Kézia Ribeiro	Experimentation in Chemistry Teaching and Indigenous Knowledge.	Master's Degree / State University of Goiás	2020
D6	Pachon, Leidy Carolina Alvarez	Scientific Dissemination in Dialogue with Indigenous Knowledge for Science Teaching: A Bibliographic Review.	Master's Degree / State University of Amazonas	2021
D7	Santos, Juscileia Florencio Dos	Perspectives on Teaching Practices that Address Ethnic-Racial Issues in Southern Amazonas.	Master's Degree / Federal University of Amazonas	2022
D8	Alves, Gabriella Karoline De Jesus	Didactic Sequence for Teaching Cerrado Ecology: An Approach from the Perspective of Indigenous Themes.	Master's Degree / University of Brasília	2022
D9	Souza, Millaany Felisberta de	Dialogue Between Science and Culture: Analysis of Final Course Papers from the Intercultural Indigenous College – UNEMAT.	Master's Degree / State University of Mato Grosso Carlos Alberto Reyes Maldonado	2022
D10	Jacques, Andressa Melo	A Proposal for Cultural Astronomy for Elementary School.	Master's Degree / Federal University of Pampa	2023
D11	Ribeiro, Fernanda Eloiza	The Teaching of Environmental Themes from the Perspective of Law 11,645/2008: What Can We Learn from Indigenous Peoples?	Master's Degree / Federal University of Minas Gerais	2023
D12	Ribeiro, Luciene Santos	Cultural Astronomy: A Learning Perspective Based on Scientific Literacy.	Master's Degree / Federal University of Amazonas	2023
D13	Goncalves, Miguel Angelo Adrian Ribeiro	Ethnoscience Through Indigenous Themes in School: Contributions of Vygotsky's Historical-Cultural Theory in the Production of an Interactive Cultural Periodic Table.	Master's Degree / Federal University of Pampa	2024

Source: Gaudêncio (2025).

Table 3 - General Overview of the Categories Analyzed in the Studies

Code	Theme	Type of Research	Data Collection	Data Analysis	Education Level	Content Addressed	Use of Law 11,645/08
T1	Chemistry teacher education and non-	Qualitative	Interview; observation; documentary analysis	CA	HE	Curricular Project of Chemistry Licentiate	Articulating axis for intercultural

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	formal spaces from the perspective of the law					Programs in Santa Catarina	teacher education
T2	Development of didactic material relating Kaingang knowledge and science teaching	Qualitative	Interview; questionnaire; observation; documentary analysis	CA and 3MP	ES	Natural sciences, chemistry, Kaingang culture, STSE	Valuing Indigenous knowledge based on the Law
T3	Interculturality in Opará villages	Qualitative	Interview; observation; documentary analysis	CA	Indigenous Basic Education	Cultural identity, science as resistance	Foundation for intercultural practices and critique of silencing
D1	Construction of scientific concepts in Indigenous school	Qualitative	Interview, participant observation; school records; interview	Elaboration of categories without established technique	ES (Indigenous school)	Natural sciences and traditional knowledges	Basis for intercultural pedagogical practices
D2	Intercultural teaching in early years in an Indigenous community	Qualitative	Case study; Interview; *in loco* observation; documentary analysis; pedagogical intervention	CA	ES	Botany, ethnobotany	Reference for the development of pedagogical practices
D3	Analysis of didactic materials/textbooks on Indigenous narrative	Qualitative, quantitative	Documentary analysis	Elaboration of categories without established technique; Hermeneutic perspective	EE	Science	Critique of superficiality and absence of the Law in materials

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D4	Pedagogical sequence for astronomy teaching from an Indigenous and African cultural perspective	Qualitative	Pedagogical intervention; classroom observation; questionnaire	3 MP; Technique not explicitly stated	HS; YAE; AE	Astronomy, Indigenous and African knowledge	Application to contextualize astronomy teaching with culture
D5	Indigenous knowledges applied to experimentation in chemistry	Qualitative	Field research; bibliographic review; pedagogical intervention; Questionnaire; interview; experiment	CA	HE (Intercultural Indigenous Licentiate Program); and HS	Chemistry and traditional practices	Development of guides (booklet) for experimental chemistry classes with Indigenous themes for the implementation of the law
D6	Review on the dialogue between scientific dissemination and Indigenous culture	Bibliographic	Academic documents; bibliographic review; investigative document strategy	DTA	Not applicable	Traditional knowledge and science	Reflection on the educational potential of the Law
D7	Teaching practices that address ethnicity in Southern Amazonas	Qualitative	Documentary research; notebook research	Snowball Sampling	ES and HS	Portuguese, mathematics, history, geography, science, ethnicity, and cultural diversity	Has not been sufficient to overcome the invisibility of ethnic-racial issues in the curriculum; points to the need for training
D8	Production of didactic sequence with Indigenous themes	Qualitative	Production and application of didactic sequence	CA	ES and HS	Ecology, *Cerrado*, Indigenous knowledge	Legal basis for contextualization and valuing of Indigenous culture

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D9	Dialogue between culture and science in final course papers	Qualitative	Documentary analysis (FCPs)	CA	HE (Indigenous licentiate program)	Cultural diversity and science	Law as an axis for critical reflection in the Indigenous curriculum
D10	Continuing teacher education	Qualitative	Questionnaire; interview	DA	ES	Cultural astronomy, Continuing education	Application using Cultural Astronomy as a mediating instrument
D11	Environmental themes from an ethnic and Indigenous perspective in the school setting for science teaching	Qualitative	Documentary research; pedagogical intervention; interviews; audio recordings; photos; textual and artistic productions	DTA	ES	Ecology	Law used to justify the insertion of traditional knowledge
D12	Cultural astronomy teaching in an Indigenous context	Qualitative	Observation; interview	DTA	ES	Astronomy and Indigenous knowledge	Law used to justify the insertion of traditional knowledge
D13	Production of a periodic table based on Indigenous culture	Qualitative	Interviews; pedagogical workshop; observations; logbook; portfolio	CA	ES	Organic chemistry	Law as support for the contextualized teaching proposal

DTA = Discursive Textual Analysis; CA = Content Analysis; DA = Descriptive Analysis; ES = Elementary School; HS = High School; HE = Higher Education; YAE = Youth and Adult Education; NYAE = New Youth and Adult Education; CAE = Center for Youth and Adult Studies; 3 MP = Three Pedagogical Moments (Delizoicov; Angoti, 2000).

3.2 Methodological Characterization of the Works and Implications for the Application of Law No. 11,645/08

The methodological analysis of the selected works in this review reveals a significant predominance of qualitative approaches (93.75%), considering the interpretive nature of

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the investigated topic. Only one of the works (D6) was characterized as a bibliographic review, not involving empirical data collection. Regarding the instruments used for data collection, a diversity of techniques is observed, with emphasis on interviews, observations of pedagogical practices, documentary analysis, and the production of didactic materials. Many studies (T2, D2, D11, D13) opted for a combination of different methodological strategies, which demonstrates a search for data triangulation and greater interpretive robustness. Approximately 79% of the research employed multiple collection instruments, which corroborates the importance of understanding the school and sociocultural contexts broadly and in depth.

Regarding the forms of data analysis, the most used were content analysis (CA) and discursive textual analysis (DTA), with significant recurrence in the corpus (Table 3). CA was present both in the systematization of empirical data and in the analysis of curricular documents and didactic materials, proving suitable for categorizing the meanings expressed in the participants' discourses and in pedagogical productions. DTA, in turn, was employed in studies with a strong interpretive component, especially those that engage with ethnoscience and decoloniality frameworks. According to Coelho, Oliveira, and Almeida (2021), the use of these forms of analysis reflects the commitment of the investigations to the cultural contexts addressed, listening to the subjects, and valuing lived experiences.

The methodological foundation of the analyzed works frequently refers to classic authors of the qualitative approach. Bardin (1977), with content analysis, and Moraes and Galiazzi (2011), with discursive textual analysis, stand out as the most utilized references for data analysis. Some studies presented less detailed methodological descriptions, which limits the understanding of the validity criteria adopted, such as studies D1 and D3, which did not name their methodological approach. This variation may be related to the different origin areas of the graduate programs and the theoretical frameworks chosen for the analyses. Even so, the overall overview indicates an effort toward methodological rigor and coherence between the objectives, the contexts investigated, and the adopted strategies.

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Works such as T2 and D4 used the three pedagogical moments (3MPs) methodology developed by Delizoicov and Angotti (2000) for the application of pedagogical sequences, with thesis T2 for chemistry teaching and dissertation D4 for cultural astronomy teaching. According to Delizoicov, Angoti, and Pernambuco (2018), this methodology is structured in three articulated stages: (1st PM) initial problematization, which starts from students' prior knowledge and reality to identify a situation that generates interest; (2nd PM) organization of knowledge, in which scientific concepts are introduced in a dialogic and contextualized manner; and (3rd PM) application of knowledge, a moment when learning is mobilized to transform reality or reinterpret the initial problem. This approach favors the construction of significant and critical knowledge, being especially compatible with intercultural and contextualized proposals.

Dissertation D7, on the other hand, used the Snowball Sampling technique to select research participants and analyze students' notebooks. This technique consists of a non-probabilistic sampling procedure, in which the first participants indicate other subjects who meet the research criteria, forming a chain of referrals. It is especially useful in contexts where direct access to participants is limited or when dealing with specific and hard-to-locate populations, such as minority groups, Indigenous communities, or educational practices that are not highly institutionalized (Vinuto, 2014). In the case of study D7, the technique allowed for the identification of teachers and students whose practices involved ethnic-racial issues, which enabled the analysis of school records (such as notebooks) with greater intentionality. Thus, it is observed that most of the analyzed research adopted a qualitative approach, using interviews and questionnaires as the main instruments for data collection, and content analysis as the predominant procedure for interpretation. Some works also resorted to classroom observations and documentary analysis, composing a diversified picture of methodological strategies. This characterization allows for understanding which investigative paths have been privileged in academic production on the law, revealing a predominance of qualitative studies aimed at interpreting teaching practices and subjects' perceptions, which evidences an effort to give voice to the concrete experiences of applying Law No. 11,645/08 in science teaching.

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In relation to the content addressed, themes such as biology, chemistry, astronomy, ecology, and natural/environmental sciences were identified (Table 6), especially in contexts linked to traditional practices and Indigenous knowledge.

Table 6 - Distribution of the Content Addressed

Content Addressed	Number of Works	Percentage (%)
Biology / Ecology / Environment	6	37
Chemistry	4	25
General Natural Sciences / Interdisciplinary	3	19
Cultural Astronomy / Physics	3	19

Source: The authors.

It is observed, among the 16 works that compose the corpus of this review, that the content related to biology, ecology, and environment are the most recurrent in the analyzed works. This may be related to the ease of articulation with Indigenous knowledge about plants, natural cycles, territories, and sustainable management practices. These themes favor the valuing of Indigenous peoples' cosmological relationship with nature, which can allow for approaches that break with the fragmented and hierarchical Western view of Science (Francisco Júnior; Yamashita, 2018).

Teachers of disciplines such as chemistry and physics often face challenges in developing methodologies that integrate scientific content with Indigenous themes in a meaningful and respectful way. This may be related both to the rigidity of curricula and the scarcity of references and didactic materials that articulate traditional knowledge with these fields of knowledge (Gaudêncio *et al*., 2025). However, some of the analyzed works demonstrate that this integration is possible. Dissertation D13, for example, proposes a "cultural periodic table," which inserts elements of Indigenous cultures into the approach to chemical elements, enabling a critical reflection on school science and its epistemologies. Thesis T2 addresses the teaching of alcoholic fermentation through the contextualization of Kaingang Indigenous knowledge about the production of fermented beverages, integrating culture, ethnoscience, and Science in the classroom. Similarly, dissertations D4, D10, and D12 use cultural astronomy as a bridge between physics and Indigenous

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cosmologies. These experiences reveal creative and innovative methodological pathways to promote an intercultural scientific education, especially when considered from a decolonial perspective.

The presence of works classified as "general natural sciences" or "interdisciplinary" allows for greater curricular flexibility and facilitates the integration between scientific and traditional knowledge. Interdisciplinarity can be a relevant methodological strategy to avoid the fragmentation of knowledge and to build bridges between school science and Indigenous epistemologies, as proposed by Fleuri (2003) and Candau (2012).

Although the focus of this work is on science teaching, it is important to highlight that other areas of knowledge have also developed intercultural approaches committed to valuing traditional knowledge, such as ethnomathematics, proposed by Professor Ubiratan D'Ambrosio (1998, 2001). This is a perspective that recognizes the existence of different ways of doing mathematics, which are socially and culturally constructed by various peoples. In Brazil, ethnomathematic has been widely discussed and applied in the field of mathematics education as a way to value Indigenous, quilombola, and popular knowledge. This conception contributes to the strengthening of intercultural educational practices in different areas of the curriculum, and its articulation with ethnoscience points to broader, more integrating, and decolonial pedagogical possibilities.

Despite the advances, there are still important themes to be explored, such as Indigenous health, ancestral technologies, life cycles, and knowledge about time and space, which could enrich science teaching from a cultural perspective. This reveals the need to expand and diversify the content covered, along with the contextualization of Indigenous knowledge and culture, promoting the recognition of Indigenous science as a component of the history of science, not to be treated as a curricular exception, but as a legitimate expression of other ways of producing and interpreting knowledge (Francisco Júnior; Yamashita, 2018).

3.3 Limits, Difficulties, and Perspectives on the Application of Law No. 11,645/08

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The analysis of the selected works reveals that Law No. 11,645/08 is being instrumentalized in different ways in the studies, and is not merely mentioned superficially or perfunctorily. Its presence is significant in the legal foundation for the inclusion of Indigenous and Afro-Brazilian knowledge and is used as a justification for intercultural pedagogical practices, serving as a criterion for critical curricular analysis (Table 3). In several works (such as T1, T2, D1, D2, D5, and D8), the Law appears as a structuring axis for pedagogical practices, being associated with the elaboration of didactic proposals, the development of materials (such as guides, booklets, and didactic/pedagogical sequences), and teacher education. In these cases, the law functions as a normative basis for the dialogue between school science and traditional knowledge, promoting the recognition of cultural diversity as an integral part of science teaching.

Other studies, such as T3 and D7, adopted a more critical approach by using the law as a mechanism for knowledge and the claiming of rights to address the absence of public policies that value ancestral cultures and knowledge, and the fight against the silencing of autochthonous languages, imposed by centuries of domination, exploitation, and prejudice (Fleuri, 2001; Florêncio; Santos, 2023; D'Angelis, 1997). These works highlight that, although the legislation has existed for more than fifteen years, its implementation is still uneven, encountering institutional resistance, a lack of adequate teacher education, and a shortage of contextualized pedagogical materials. In these cases, the law is used in the works as an instrument of denunciation and problematization.

There are also works that use it as a reference for curricular and documentary analysis, such as D3 and D6, evidencing gaps, superficialities, and the need for greater depth in the approach to Indigenous and Afro-Brazilian cultures in didactic materials. The analysis reveals that Law No. 11,645/08 is a powerful device, both for concrete pedagogical transformations and for structural questioning of the school curriculum. However, its implementation still occurs in a fragmented manner, depending heavily on the initiative of committed teachers, researchers, and outreach groups focused on interculturality and decoloniality in science teaching.

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The presence of Law No. 11,645/08 in works aimed at teacher education highlights its relevance as a structuring element of initial and continuing education policies. Studies such as T1 and D9, for example, explore the application of the law in chemistry licentiate programs and in programs aimed at the education of Indigenous teachers, showing how it can contribute to pedagogical practices more sensitive to ethnic-racial diversity.

In the case of thesis T1, the law is addressed as an articulating axis for intercultural teacher education, being mobilized in teaching activities in non-formal spaces, such as museums and science centers, in order to integrate scientific knowledge and traditional knowledge. The author reinforces that, in the case of chemistry licentiate programs in Santa Catarina, it is noted that the insertion of Law No. 11,645/08 in their Curricular Projects (PCC) still needs to be better explored, as well as the approach to the histories and cultures of the Guarani, Kaingang, and Laklãnõ peoples. The author believes that the absence of these histories reveals the silencing of the ethnic plurality contained within the term "Indigenous" (Gorri, 2020). Dissertation D9, in turn, investigates the production of final course papers (FCPs) in Indigenous licentiate programs, in which the law is appropriated as a critical tool for curricular reinterpretation.

In general, these experiences reveal that, when incorporated into initial and continuing education, the law can contribute significantly to the construction of teaching knowledge committed to diversity, inclusion, and the valorization of historically marginalized knowledge. Despite these advances, the analysis reveals that teacher education is still one of the main challenges for the effective implementation of the law. Authors like Candau (2012) and Moreira (2019) issue a warning about persistent challenges, such as the absence of specific training or discipline, of formative materials, and of critical approaches to ethnic-racial themes in licentiate programs, in addition to institutional resistance. These elements indicate that the implementation of the law requires curricular adjustments and a paradigmatic shift in the very conception of scientific education and teacher education. Although referenced as a legal basis, Law No. 11,645/08 can be applied superficially when not accompanied by transformations in the curriculum, methodological approaches, and the critical training of teachers. As Moreira (2019) warns,

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it is not enough to include content about Indigenous and Afro-Brazilian cultures; it is necessary to question the epistemological foundations of the curriculum and promote a real decolonization of knowledge. Thus, it is necessary to reinforce the role of universities and graduate programs in the consolidation of pedagogical practices committed to interculturality, social justice, and the decoloniality of knowledge.

Some authors (Melo; Ribeiro, 2019; Santiago; Akkari; Marques, 2013; Candau, 2012) emphasize that teacher education constitutes a fundamental axis for the consolidation of intercultural pedagogical practices. The effectiveness of Law No. 11,645/08 depends on the normative inclusion of the theme in curricula and the critical and continuous training of teachers, capable of promoting the recognition of Indigenous and Afro-Brazilian epistemologies as legitimate and knowledge-producing. In this sense, teacher education cannot be limited to the transmission of content, but must involve the reconfiguration of pedagogical practices, the dialogue between knowledge, and the construction of an ethical and political stance committed to diversity and equity. Regarding the type of approach for promoting Indigenous themes, there is a tendency toward the generalization of the category "Indigenous" in various works, even beyond those selected, that do not consider the diversity of peoples, languages, cosmologies, and socioterritorial contexts that compose Indigenous cultures in Brazil. According to Gorri (2020), the lack of this specific approach to local ethnicities in academic works in general, such as the Guarani, Kaingang, Laklãnõ, and Yanomami peoples, for example, demonstrates that a homogeneous and abstract view of Indigenous peoples still persists, which impoverishes the possibilities for constructing a truly intercultural education.

Another challenge to be noted is the absence of articulation between the legislation and educational public policies at the municipal, state, and federal levels. Law No. 11,645/08, when not accompanied by structured programs for teacher training, calls for the production of materials, and inclusion in evaluation systems, tends to be limited to the individual initiative of committed teachers and researchers. This lack of articulation compromises the continuity and institutionalization of intercultural actions in science teaching (Candau, 2012).

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Despite the cited difficulties, the analyzed works also evidence creative experiences, such as the use of intercultural didactic sequences, the production of games, guides, and contextualized pedagogical proposals. These actions demonstrate that Law No. 11,645/08 can be an instrument for the transformation of science teaching, provided it is articulated with a critical formative perspective, dialogue with territories, and the valuing of local knowledge. In this sense, strengthening research and outreach networks, investing in teacher education, and promoting the collaborative production of materials are promising pathways to consolidate truly intercultural and decolonial pedagogical practices.

4 Final Considerations

This systematic review allowed for mapping and analyzing how Law No. 11,645/08, with a focus on Indigenous themes, has been mobilized in theses and dissertations on science teaching. The results reveal that, although limited in number, the analyzed works use the legislation significantly, both as a legal basis and as a pedagogical instrument to value interculturality, Indigenous knowledge, and decolonial approaches. A predominance of content related to biology, ecology, and the environment was observed, in dialogue with traditional knowledge. Teacher education emerges as one of the major challenges, evidencing gaps in curricula, a lack of specific materials, and methodological difficulties in critically integrating Indigenous knowledge.

The implementation of the law remains uneven, often restricted to the actions of engaged researchers. Thus, the need for public policies focused on teacher education, the production of intercultural materials, and the articulation between teaching, research, and outreach is reinforced. It is concluded that the valuing of Indigenous and Afro-Brazilian knowledge must be a structuring component of a critical and anti-racist scientific education, especially in historically neglected contexts, such as early childhood education, youth and adult education (YAE), and Indigenous schools.

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