

EDUCATING SCIENCE TEACHERS FOR ETHNIC-RACIAL RELATIONS: A
SYSTEMATIC REVIEW OF THE LITERATURE

*FORMAÇÃO DE PROFESSORES DE CIÊNCIAS PARA AS RELAÇÕES ÉTNICO-
RACIAIS: UMA REVISÃO SISTEMÁTICA DA LITERATURA*

*FORMACIÓN DEL PROFESORADO DE CIENCIAS PARA LAS RELACIONES
ÉTNICO-RACIALES: UNA REVISIÓN SISTEMÁTICA DE LA LITERATURA*



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ABSTRACT: The subject of this article is the education of science teachers for ethnic-racial relations. The objective is to know the panorama of studies on the theme of ethnic-racial relations in teacher education. This is qualitative research, carried out from a Systematic Literature Review, which sought works in the Portal de Periódicos of CAPES and in the magazine *Química Nova na Escola*. We used the descriptors “Teacher Education”, “Science Teaching” and “Ethnic-Racial Relations”, locating a sum of 391 scientific articles. After the selection, we considered five texts as the final sample of the review. We can infer that the studies presented a gap on the subject of science teacher education for ethnic-racial relations and that an incentive from the academy is necessary for this gap to be effectively filled.

KEYWORDS: Ethnic-racial relations. Teacher education. Science teaching.

RESUMO: Este artigo tem como temática a formação de professores de ciências para as relações étnico-raciais. O objetivo é conhecer o panorama dos estudos sobre a temática das relações étnico-raciais na formação de professores. Trata-se de uma pesquisa qualitativa, realizada a partir de uma Revisão Sistemática de Literatura, que buscou trabalhos no Portal de Periódicos da CAPES e na revista *Química Nova na Escola*. Utilizamos os descritores “Formação de Professores”, “Ensino de Ciências” e “Relações Étnico-Raciais”, localizando um somatório de 391 artigos científicos. Após a seleção, consideramos cinco textos como amostra final da revisão. Podemos inferir que os estudos apresentaram uma lacuna sobre a temática da formação de professores de ciências para as relações étnico-raciais e que é necessário um incentivo da academia para que este hiato seja efetivamente preenchido.

PALAVRAS-CHAVE: Relações étnico-raciais. Formação de professores. Ensino de Ciências.

RESUMEN: Este artículo tiene como tema la formación de profesores de ciencias para las relaciones étnico-raciales. El objetivo es conocer el panorama de estudios sobre el tema de las relaciones étnico-raciales en la formación docente. Se trata de una investigación cualitativa, realizada a partir de una Revisión Sistemática de Literatura, que buscó trabajos en el Portal de Periódicos de la CAPES y en la revista *Química Nova na Escola*. Se utilizaron los descriptores “Formación Docente”, “Enseñanza de las Ciencias” y “Relaciones Étnico-Raciales”, localizando una suma de 391 artículos científicos. Después de la selección, se consideraron cinco textos como muestra final de la revisión. Podemos inferir que los estudios presentaron un vacío en el tema de formación de profesores de ciencias para las relaciones étnico-raciales y que es necesario un incentivo desde la academia para que este vacío sea efectivamente llenado.

PALABRAS CLAVE: Relaciones étnico-raciales. Formación de profesores. Enseñanza de las ciencias.

Introduction

Studies on ethnic-racial relations have grown significantly in the 21st century. This occurred due to social demands and the increase in black movements, especially in the 2000s, when the Workers' Party (2003) was in power in the Brazilian government. This year, Law no. 10.639/2003, making the teaching of African and Afro-Brazilian history and culture mandatory (Brazil, 2003), modifying article 26 of the Education Guidelines and Bases Law (LDB 9394/1996).

Then there was the creation of Law no. 11,645/2008, which deals with the mandatory teaching of African, Afro-Brazilian and indigenous history and culture throughout the Brazilian school curriculum. These laws were published as a result and in line with the need to meet the needs of this portion of the Brazilian population that experienced the legacy of a slave past, racial and economic inequality, among other forms of exclusion, which left historical marks on the black subject.

Aspects in teaching and educational training hindered the access of these individuals, as well as the role played by formal education in the face of ethnic-racial issues, reproducing prejudice and discrimination, restricting access, permanence and success, leaving their history and its culture displaced from the center of the debate for decades. These legislations were important so that this group that now had access to school felt represented in the school environment, in the curriculum and in the entire educational process.

These actions were emergency because despite attending school, black people were not represented in the content that was taught during their training. What happened was cultural and historical exclusion, the reinforcement of inequality in a dualistic environment of educational provision, that is, different training: child of the poor, worker, working class and/or black versus child of the rich. This is because, historically, the idea of race as a biological and scientific construct has been used to justify discrimination, prejudice and oppression of ethnic groups in different societies over time (Dias *et al.*, 2018).

To implement these legislations, the National Plan for the Implementation of the Curricular Guidelines for the Education of Ethnic-Racial Relations and for the Teaching of African and Afro-Brazilian History and Culture was enacted (Brazil, 2013). With the aim of serving this population, teaching the contributions that black and indigenous peoples made to the construction and institution of Brazil is mandatory in the curricula. Currently, there are other barriers to be overcome, and there is an urgent need for education on ethnic-racial relations in teacher education, especially and specifically in this article, for teacher education in science.

The specificities of the racial issue in Science teaching are evident in several aspects. Firstly, it is important to recognize that the historical influence of natural sciences in the construction of the concept of race is still reflected in current teaching. Curricula and teaching materials often do not critically address the history of racialization in science, which can perpetuate stereotypes and prejudices (Dias *et al.*, 2018). Additionally, lack of representation is a significant barrier.

The science classroom can also inadvertently pose barriers to learning related to ethical issues. By neglecting the contributions of scientists from different ethnic backgrounds, the school may convey the message that only certain groups have a legitimate role in science, to the exclusion of other valuable perspectives.

From this perspective, it is important to highlight that the progress of studies and investigations that deal with this topic is notable. The growth in academic research aimed at training teachers for ethnic-racial relations is visible in publications from various databases.

Furthermore, the ethical implications of scientific discoveries are often not adequately discussed. As mentioned previously, some scientific theories in the past have been influenced by racial prejudices. It is essential to approach these theories critically, contextualizing them historically and highlighting how Science can be affected by bias and discrimination.

In this context, this article questions: how has the theme of ethnic-racial relations in the training of science teachers been addressed and discussed in academic articles produced in Brazil? The objective is to carry out a mapping through a systematic review and content analysis of national academic articles that deal with the training of science teachers for ethnic-racial relations.

Therefore, this text is organized as follows: a) presentation of the methodological path, with the composition and extraction of data from the systematic review process; b) results and discussions, containing the analytical synthesis of the reviewed articles, as well as the systematic analysis; c) final remarks and some notes; d) references that were part of the systematic literature review.

Methodological path

This article is a qualitative study, of an exploratory and investigative nature. To collect and organize the data, we followed, respectively, guidelines on systematic review by Angelo Costa and Ana Paula Zoltowski (2014) and content analysis by Laurence Bardin (2016).

According to Costa and Zoltowski (2014, p. 56, our translation), “the systematic review is a method that allows you to maximize the potential of a search, finding the largest possible number of results in an organized way”. Therefore, it is a method that limits bias and generates greater reliability and precision of results, and which can be carried out through eight basic steps:

1. Delimitation of the question to be researched; 2. Choice of data sources; 3. Choosing keywords for search; 4. Search and storage of results; 5. Selection of works based on the abstract, according to inclusion and exclusion criteria; 6. Extraction of data from selected articles; 7. Evaluation of articles; 8. Data synthesis and interpretation (Costa; Zoltowski, 2014, p. 54, our translation).

The following definition was chosen for the research corpus, following the guidelines of Costa and Zoltowski (2014) mentioned above: a publication period that was as comprehensive as possible, considering that the theme of education for ethnic-racial relations is a recent topic (mandatory after the implementation of the Law 10,639/2003); specific search descriptors and filters; choice of at least two databases for the selection of scientific articles (Capes Periodicals and *Química Nova na Escola* magazine); finalization of the documentary corpus for analysis, with a number of five articles.

The use of these two databases is justified because, in CAPES Journals, the works are generally peer-reviewed and maintain high quality standards. They are, therefore, considered reliable sources of academic and scientific information, in addition to offering access to a wide range of regularly updated journals. This allows researchers to access the latest discoveries and developments in their areas of interest.

Therefore, the use of CAPES journals is important to ensure that the literature review is based on reliable, current and diverse sources, which contributes to the quality and validity of the research in general. Furthermore, by using national resources, researchers also support and strengthen scientific production in Brazil.

“*Química Nova na Escola*” is a Brazilian publication, which makes it especially relevant for teachers and students who are inserted in the educational context of Brazil. Articles can address specific issues in the teaching of Chemistry in the country, as well as in the area of

Science. The magazine frequently presents articles that discuss new approaches, techniques and technologies in teaching Chemistry in the classroom context. This allows teachers to stay up to date with educational trends and innovations in the field. By using the magazine's resources, teachers can improve their teaching practices, develop new pedagogical strategies, and enrich their knowledge base about teaching Chemistry.

Therefore, the use of the literature review from the magazine “Química Nova na Escola” is important to ensure that teachers have access to updated and relevant information for teaching Chemistry, promoting the quality and effectiveness of the educational process in this discipline. Furthermore, this text is the result of ongoing research on the topic of Chemistry teacher education. In this sense, the inclusion of the magazine was prioritized.

Figure 1 – Diagram of the stages of the Systematic Review methodological path



Source: Cruz, Lima, and Nascimento (2020, p. 121)

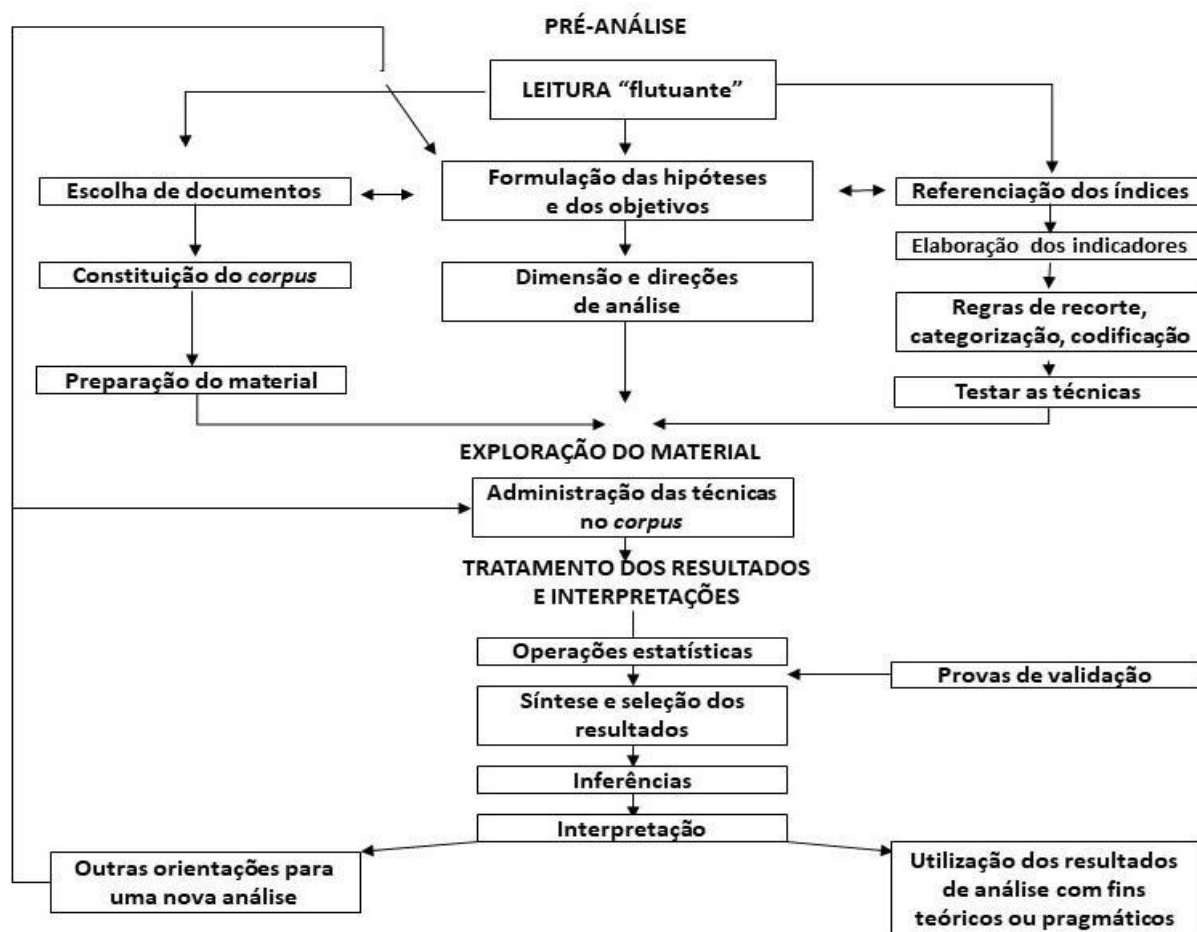
In order to investigate what has been produced in Brazil on the research question **of how the theme of ethnic-racial relations in the training of science teachers has been contemplated and discussed in academic articles**, we used the combination of descriptors/keywords supported by a research protocol that includes the definition of inclusion and exclusion criteria.

Keywords summarize the main concepts or variables investigated in a given study. Note that to select articles for the systematic review, the keywords need to be sensitive enough to adequately access the phenomenon, indicating a representative number of works. However, they cannot be too sensitive,

returning too many results, making the review project unfeasible (Costa; Zoltowski, 2014, p. 64, our translation).

As an inclusion criterion, we used the presence of the descriptors “teacher education”, “Science Teaching” and “Ethnic-Racial Relations” in the titles, keywords, abstracts or in the body of the text of the works. Along with this, we also opted for work that was available online and in Portuguese. For exclusion, we considered works that did not present the investigated descriptors and those that did not address ethnic-racial relations in the training of science teachers. Below, we present the results found in this search and the analysis that was carried out as recommended by Bardin (2016, p. 132).

Figure 2 – Development of a content analysis according to Bardin (2016)



Source: Bardin (2016, p. 132)

Initially, the selection was made based on the search for descriptors/keywords in the databases, according to the quantity presented. A specific period was not delimited, in order to cover a greater number of articles.

Table 1 – Search result based on selected keywords in Capes Periodicals

Key words	Period covered	Filter	Free access	CAFe Access
“Teacher education” and “Ethnic and Racial Relations”	1999-2021	-	204	205
“Teacher Education” and “Ethnic and Racial Relations”	1999-2021	Peer Reviewed	84	85
“Science Teaching” AND “Ethnic-Racial Relations”	2010 – 2021	-	32	32
“Science Teaching” AND “Ethnic-Racial Relations”	2010 – 2021	Peer Reviewed	16	16
“Teacher Education”, “Science Teaching” and “Ethnic and Racial Relations”	2010 – 2021	-	15	15
“Teacher Education”, “Science Teaching” and “Ethnic and Racial Relations”	2010 – 2021	Peer Reviewed	8	8
TOTAL		-		361

Source: Prepared by the authors

When searching and storing data, we used a combination of the keywords “teacher education”, “Science Teaching” and “Ethnic-Racial Relations”. The “Peer Reviewed” filter was applied because we understood that it would bring more qualified productions and research to this review.

We also chose to filter between Free Access and CAFe Access, as recent research such as that of Cruz, Lima, and Nascimento (2020) demonstrated different quantities and larger variables in relation to this type of access to the database. However, we realized that, with the topic researched, this happened differently, as the numbers did not fluctuate much.

Regarding the descriptors “teacher education” and “Ethnic-Racial Relations”, the articles that appeared dealt with the training of teachers in other areas, mainly pedagogy, physical education and history. The issue of training science teachers for ethnic-racial relations appears duplicated with the other descriptors researched.

In the article selection stage, checking the title and summary, according to the inclusion and exclusion criteria, we also filtered texts that were available online and those in Portuguese. After removing the duplicates, we have Table 1.

Table 1 – Selected articles in Capes Periodicals

	Title	Authors	Periodical	Year
A1	Citizenship, Ethnic-Racial relations and education: challenges and potential of science teaching	Douglas Verrangia; Petronilha Beatriz Gonçalves e Silva	Education and Research, São Paulo.	2010
A2	Education for Ethnic-Racial relations in the training of Chemistry teachers: about law 10,639/2003 in higher education	Marysson Jonas Rodrigues Camargo; Anna Maria Canavarro Benite	New Chemistry	2019
A3	Con(di)vergent path for the education of ethnic-racial relations in undergraduate courses on the JK campus of UFVJM	Marcelo Siqueira Jesus; Alan Silva Aguiar	Rev. Resume Space (online)	2020

Source: Prepared by the authors

We also explored the magazine **Química Nova na Escola**, with the combination of the keywords “teacher education”, “Science Teaching”, and “Ethnic Racial Relations”, 30 articles were retrieved.

After adding the exclusion and inclusion criteria, reading the titles and abstracts, we selected 7 that dealt with the combination of the descriptors researched, those being: teacher education and science teaching for ethnic-racial relations.

Table 2 – Selected articles in Química Nova na Escola

	Title	Authors	Key words	Section	Year
A4	Chemistry Teaching Proposals focused on Questions Ethnic-Racial: an experience in the degree and its developments for the middle level	Luciana Massi, Carlos Aparecido Alves Moris, Camila Toledo Piza, Carolina Martins Primo, Elliston Mazela da Cruz, Eloisa Marques de S. Facirolli, Francine Ferreira de Carvalho, João Victor Callera Pedroso, Melany Isabel Garcia Nicholson and Thiago Lima Ferreira	Ethnic-Racial issues, degree in Chemistry, teaching proposals	Chemistry and Society	2020
A5	There's palm oil, there's axé, there's chemistry: About history and African and Afro-	Juvan P. da Silva, Antônio CB Alvino, Marciano A. dos Santos, Vander L. dos Santos and	Teaching chemistry, palm oil, Law 10639	Open space	2017

	Brazilian culture in chemistry teaching	Anna M. Canavarro Benite			
A6	The Biochemistry of Candomblé – Teaching Possibilities Application of Federal Law 10639/03	Patrícia FSD Moreira, Guimes Rodrigues Filho, Roberta Fusconi, Daniela FC Jacobucci	Candomblé, federal law 10639/03, chemistry, biochemistry	-	2011
A7	Disciplinary Interfaces in Science Teaching: A Teaching Perspective	Tania DM Salgado, Maria Cecília C. Moço and Maria Teresinha X. Silva	Interdisciplinarity, natural sciences, degree	The Student in Focus	2019
A8	Milk in “breast” Africa and Education for Relationships Ethnic-Racial (ERER) in Chemistry Teaching	Juvan P. da Silva, Gustavo AA Faustino, Antônio CB Alvino, Claudio RM Benite and Anna MC Benite	ERER, milk, chemistry	Chemistry and Society	2020
A9	Art in Education for Ethnic-Racial Relations: A Dialogue with Chemistry Teaching	Erasmus MS Silva and Wilmo E. Francisco Junior	Art, social semiotics, melanin, coffee	Open space	2018
A10	Iron metallurgy in Africa: Law 10,639/03 on Chemistry Teaching	Antônio CB Alvino, Aliny G. Silva, Geisa LM Lima, Marysson JR Camargo, Marilene B. Moreira, Anna MC Benite	African technology, Law no. 10,639/2003, iron	Teaching Chemistry in Focus	2020

Source: Prepared by the authors

When there was proximity to the thematic proposal of the investigation, detailed reading was carried out to identify the effective combination of research descriptors.

With the selection through “floating” reading, as advised by Bardin (2016, p. 126), this being an activity of contact with the texts, gradually getting to know them more precisely in order to be able to filter them according to the objectives established for selection, an effective combination of descriptors was generated, so that the articles discussed the training of science teachers for ethnic-racial relations.

The texts highlighted in tables 1 and 2 only mention teacher education, however, they do not effectively discuss this descriptor in their research, that is, they do not address and discuss it in detail and in depth in their research. They make a brief reference to teacher education, but did not fully explore this descriptor in their research.

Therefore, it ends with five articles, which proceed with the reading and analysis stage, as these covered the criterion of the *Rule of Representativeness* and *Relevance*, according to Bardin (2016, p. 127, our translation), and the analysis of the selected sample “It is said to be rigorous if the sample is a representative part of the initial universe”, that is, it can be generalized to the initial whole of the floating reading and analysis process.

Next, the stage that Bardin (2016) points out as material treatment and coding took place, which corresponded to the transformation of data from the articles selected as a sample

through clippings, aggregation, representation of the content and its expression, so that it could be clarify the question initially proposed: how the theme of ethnic-racial relations in the training of science teachers has been contemplated and discussed in academic articles produced in Brazil.

Results and discussions

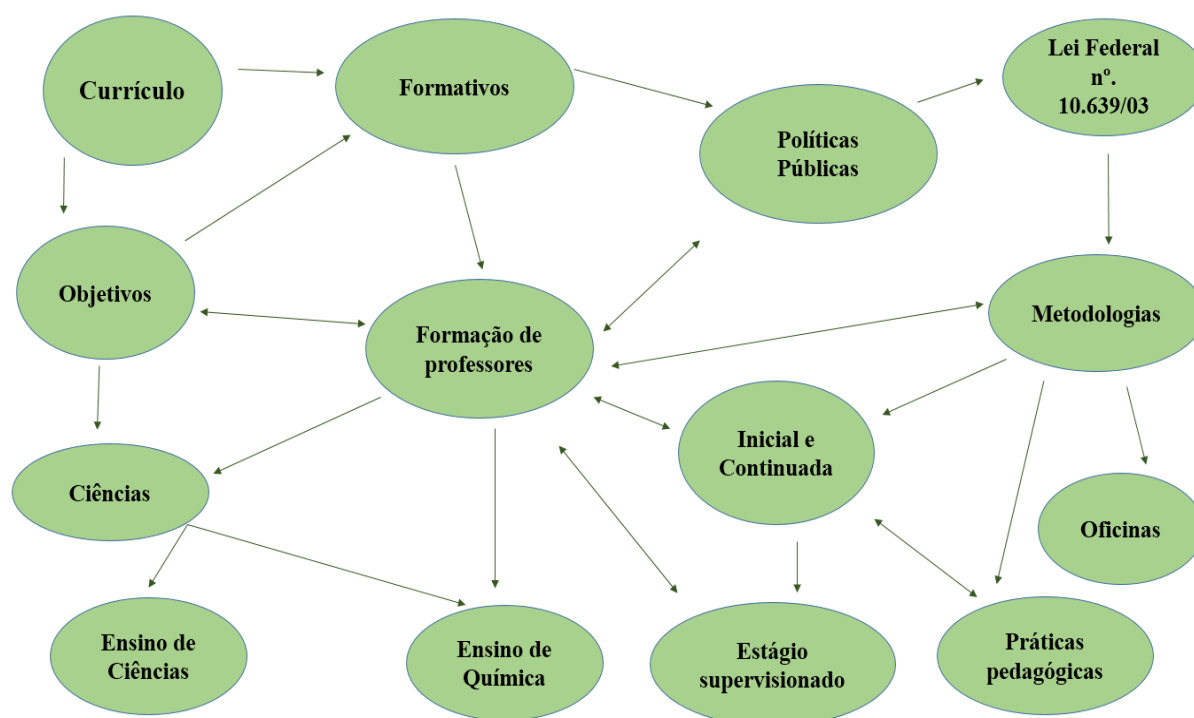
In the content analysis process, as advised by Bardin (2016), we carefully read the selected articles and, through this, the texts could be referenced, which consists of creating indices and indicators, which are, respectively: terms, words and expressions that stand out during reading and their frequency. This process is important for carrying out coding and analysis, so that we understand the trends and indices present in these studies, as shown in Figure 3.

Trends and indices are the explicit themes in the works analyzed, considering that these terms often appear frequently. From these it was possible to construct a *posteriori categories* that cover the texts in general: Central theoretical basis; Subjects covered and participants; Research fields; and Methods and methodologies.

Therefore, we filtered the theoretical and empirical categories found in the texts *a posteriori* in more detail as presented in the works.

- a) Central theoretical basis: Nilma Lino Gomes (A2; A3; A4; A5); Paulo Freire (A10);
- b) Subjects: Teachers (A2), higher and secondary education students (A4; A5; A10);
- c) Research fields: High School (A5; A10) and Higher Education (A2; A3; A5; A10), Degrees (A2; A4), University (A3; A10);
- d) Methods and methodologies: documentary (A3), proposal for workshops and/or intervention (A2; A4; A5), participant observation (A10).

Figure 3 – Trends and indexes of selected articles



Source: Prepared by the authors

Based on these trends and indices and then the construction of the categories *a posteriori*, systematic analysis, inferences and interpretations of scientific articles were carried out based on the category that deals with the central theoretical basis.

It is important to highlight that for the specific analysis of this article, we considered the Central theoretical basis category with its inferences and interpretations, starting from the registration units of the five selected articles.

Systematic analysis process: inferences and interpretations

Regarding the theoretical basis of the selected articles, which combined the descriptors of the systematic review, the researchers used the author Nilma Lino Gomes in 4 articles (A2; A3; A4; A5), and the only article (A10) that was not guided by Gomes and started from the works of Paulo Freire: *Pedagogy of autonomy: knowledge necessary for educational practice* (1996), *Pedagogy of the oppressed* (2005), *Extension or communication?* (1979).

The author Nilma Gomes has, in her list of studies, themes that deal with Education, the Curriculum, Black Identity, the Body, teacher education, the Fight against Racism, among other works on Ethnic-Racial relations. “Nilma Lino Gomes and others, developed pedagogical

intervention strategies to implement law 10639/03” (Camargo; Benite, 2019, p. 693, our translation).

According to Jesus and Silva Aguiar (2020), the author Nilma Lino Gomes (2012)

It suggests the inclusion of Afro-Brazilian content to promote effective education for race relations. [...] overcoming the Eurocentric perspective of knowledge and the world becomes a challenge for schools, educators, the curriculum and teacher education (Jesus; Silva Aguiar, 2020, p. 855, our translation).

In the same vein, Massi *et al.* (2020, p. 210) states that Nilma Lino Gomes (2006) contributes to this theme of racial relations, as “historically, in Brazil, the construction of black identities went through complex processes of resignification that ranged from the marks left by slavery to the diverse struggles of black resistance.” And that, in fact, it is through these processes of construction of identities, resistance and tensions “that hair becomes a form of expression and sociocultural resistance, in addition to causing forms of oppression motivated by racism” (Massi *et al.*, 2020, p. 210, our translation). Furthermore,

The treatment of hair stands out in the synthesis of the complex and fragmented process of construction of black identity, both for black men and women: curly hair carries cultural, political and social meanings that locate them within an ethnic-racial group (A4, 2020, p. 210, our translation).

The research by Silva *et al.* (2017) is based on Nilma Lino Gomes (2003) to argue that it is essential to understand and consider the importance of the articulation between culture, black identity and education. Although it is not an easy task, this articulation must occur in all educational spaces, formal and informal.

The author Nilma Lino Gomes, one of the main references in the field of Afro-Brazilian education, is cited as a central theoretical foundation in these analyzed works (A2; A3; A4; A5) for the construction of a curriculum and teacher education that goes beyond the perspective Eurocentric and promote inclusion and racial equity.

In this sense, some reflections may emerge from these excerpts of registration and context units present in the selected articles, such as the fact that teacher education for the education of ethnic-racial relations is a challenge, as it requires a process of deconstruction of prejudices and stereotypes. The Eurocentric perspective is still dominant in the school curriculum, which makes inclusion and racial equity difficult. Thus, the inclusion of Afro-Brazilian content in the school curriculum is an important step to promote education on race

relations. Therefore, teacher education must be guided by the perspective of education on ethnic-racial relations, so that teachers can promote inclusive and equitable education.

Based on these reflections, specifically on the training of science teachers for ethnic-racial relations, Gomes (2012) states that it is necessary to decolonize the curriculum, which is a great challenge due to its rigidity.

We have already denounced much about the rigidity of curricula, the impoverishment of the content character of curricula, the need for dialogue between school, curriculum and social reality, the need to train reflective teachers and about the cultures denied and silenced in curricula (Gomes, 2012, p. 102, our translation).

Gomes' (2012) statement highlights several critical issues and challenges in the educational system, including the need for more flexible and contextualized curricula, the importance of reflective teacher education and the need to guarantee the representation and appreciation of the diverse cultures present in the Brazilian society. These are essential considerations in promoting an education that reflects Brazil's ethnic-cultural diversity and the contribution and history of people of African descent.

Therefore, it is understood that the research that deals with the training of science teachers for ethnic-racial relations found and selected in the process of constructing this article has the author Nilma Lino Gomes as its central theoretical basis.

Another basis is found in Alvino *et al.* (2021), who is Paulo Freire, who is also included in this discussion, because whatever the area of training, education must be dialogical, as recommended by the author. To do this, it is necessary to understand that “experiencing dialogue [...] means not invading, not manipulating, not *sloganizing*”. Being dialogic means committing to the constant transformation of reality” (Freire, 1979, p. 43, our translation).

In the research by Alvino *et al.* (2021) Freire contributes significantly, as he presents an education perspective that is not contemplated in the transfer of knowledge, but as a possibility for its construction or production, “understanding that learning is built in the teacher – student interaction [...] In this context, education is dialogue, communication between teachers and students around a context or concepts” (Alvino *et al.*, 2021, p. 394-398, our translation).

In this sense, supported by Freire (2005) and the work of A10, Alvino *et al.* (2021) asserts that

Education is essentially dialogue, that is, there is only learning if there is communication in the classroom. Thus, the teacher who denies dialogicity as

the essence of education, narrating or dissecting content, only leads students to mechanical memorization (Alvino *et al.*, 2021, p. 398, our translation).

The excerpts presented from Alvino *et al.* (2021) highlight the importance of the dialogical approach in education, specifically when considering the implementation of Law No. 10,639/2003 in the teaching of Chemistry, mainly influenced by Paulo Freire's perspective. The emphasis is on the idea that the educational process should not be limited to the mere transmission of knowledge, but rather be an opportunity for the construction and production of knowledge.

The dialogue between teacher and students is highlighted in Alvino *et al.* (2021) as the core of learning, and the denial of this essence can result in a limited educational approach, based on rote memorization. Therefore, adopting the dialogical approach proposed by Freire is fundamental to promoting a truly transformative and participatory education, which enables students to understand and actively transform the reality around them.

Regarding Federal Law No. 0.639/2003, which implements the mandatory teaching of Afro-Brazilian and African history and culture in the country's schools, all five articles discuss this legislation, which constitutes a major advance towards the consolidation of cultural plurality and ethnic-racial diversity, and a milestone in the anti-racist struggle and the achievement of rights for the black community in Brazil. However, this research highlights the effective need for its implementation, as well as its application in the training of teachers in all areas. "This is a discussion that should be part of the teacher education process" (Gomes, 2005, p. 148, our translation). The author also provides guidance on Law No. 10,639/2003:

The introduction of Law No. 10,639/03 – not as more subjects and new content, but as a cultural and political change in the curricular and epistemological field – could break the silence and reveal this and other pedagogical rituals in favor of racial discrimination (Gomes, 2012, p. 105, our translation).

The Supervised Internship was identified as a fundamental moment in teacher education, to implement education for ethnic-racial relations, in which the teacher in training can go through a moment of pedagogical intervention and experience diversity in their curriculum, which will encourage dialogue in the internship field with anti-racist teaching.

During the entire selection and analysis process to finalize this review, it was clear, from the selected sample, that research on teacher education in the areas of science for ethnic-racial relations is still incipient.

It would be simplifying the problem to say that everything we produce on the racial issue in education and other areas of knowledge can be used and applied to teacher education. We are faced with the challenge of analyzing the existing academic production on race relations in Brazil and discussing which aspects of this production should be part of the teacher education processes (Gomes, 2003, p. 169, our translation).

What we found were varied research on teaching practices, pedagogical workshops, specific disciplines and other discussions that did not deal with training science teachers for ethnic-racial relations.

The framework of research/scientific articles published on teacher education for ethnic-racial relations is mostly focused on degrees in the areas of History, Pedagogy, Philosophy, Literature, Arts and Physical Education, and in the areas of science, including Mathematics, Chemistry, Physics and Biology, there is still a gap regarding the aspect of ethnic-racial relations.

The analysis of the selected articles revealed the importance of solid theoretical bases for teacher education. Author Nilma Lino Gomes emerged as a central figure in this debate, highlighting the need for education that goes beyond the mere transmission of knowledge, promoting reflection, dialogue and the constant transformation of reality. Paulo Freire was also recognized as a central theoretical foundation, emphasizing the importance of dialogue in the construction of knowledge.

One cannot fail to consider, however, in this discussion that, when conducting this systematic review from two databases, it is important to take into account that this approach may limit the representativeness of the research, as some studies may not be included. Although the Capes Periodical Bank comprehensively covers research in Brazil, it may leave aside texts available on the subject in theses and dissertations, for example.

Another point is that methodological rigor is crucial to guarantee the validity of the results, but be aware that excessive rigor can exclude pertinent work and limit flexibility in approaching the topic. Therefore, it is considered crucial to maintain a critical eye on methodological choices and find a balance between rigor and comprehensiveness in research.

Although this approach may have limitations in terms of representativeness, it offers a solid basis for analysis. When considering methodological rigor, one realizes the importance of finding a balance between precision in the selection of studies and the inclusion of valuable works that contributed to the research. In any case, it is important to highlight that the choice to conduct this systematic literature review represents a significant step in the search for a

comprehensive understanding of the topic of science teacher education for ethnic-racial relations.

Final remarks

The implementation of Federal Law No. 10,639/2003, which requires the teaching of Afro-Brazilian and African history and culture, was identified as a significant advance in promoting ethnic-racial diversity in the school curriculum. However, research also points to the need to implement this legislation and integrate it effectively into the training of teachers in all areas, especially in science.

It is necessary to encourage the academic community in the areas of science, as well as teacher education researchers, to carry out research and investigations on this topic that is so fundamental and necessary for Education. Therefore, we agree with Gomes (2003), when he states that there is another challenge, “that of discovering how the production on black people and their culture, carried out by other areas of knowledge, can help us reflect on the theme of black people and education” (Gomes, 2003, p. 169, our translation). So that it can then culminate in “enriching and pointing out new paths for the field of teacher education” (Gomes, 2003, p. 169, our translation).

Aiming to achieve an epistemological and symbolic change within the school space and in the Basic Education curriculum, participation, commitment and involvement of the academic community in the application and effective implementation of Law No. 10,639/2003 must occur. This could even lead to a change in the training of science teachers, in addition to significantly influencing an entire population.

The supervised internship was highlighted as a crucial moment in teacher education, providing opportunities for pedagogical interventions and the experience of diversity in the curriculum. However, it was evident that there is still a gap in research on the training of science teachers for ethnic-racial relations. The existing academic production mainly addresses degrees in areas such as History, Pedagogy, Philosophy, Literature, Arts and Physical Education, demonstrating the need to expand the focus to include the disciplines of Mathematics, Chemistry, Physics and Biology in this training process.

Therefore, ethnic-racial relations in the Science classroom can manifest themselves through a lack of representation, stereotypes, different experiences and inequalities in access. Contributing to avoiding these manifestations by promoting a critical view of racism and

prejudice, encouraging reflection on one's own identities and prejudices and offering teaching materials and resources that promote representation. Teacher education can diversify the curriculum, develop inclusive strategies, promote dialogue and address contemporary issues. Which can contribute to an inclusive and equitable learning environment.

In this sense, the research analyzed highlights the importance of teacher education that is sensitive to ethnic-racial issues, highlighting the need for an interdisciplinary approach that effectively incorporates cultural diversity and promotes inclusive and equitable education. This study also highlights the importance of continuing research and development of innovative pedagogical strategies that address ethnic-racial relations in the context of science disciplines.

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